W. B. No. [illegible]

U. S. DEPARTMENT OF AGRICULTURE
WEATHER BUREAU

MONTHLY WEATHER REVIEW

VOLUME 54, No. 2

FEBRUARY, 1926

WASHINGTON
GOVERNMENT PRINTING OFFICE
1926

FEBRUARY, 1926

CONTENTS

CONTRIBUTIONS, ABSTRACTS, AND BIBLIOGRAPHY

Page

Papers on the relation of the atmosphere to human comfort. C. Dorno. (2 figs.) 39

Sixteen years of snow-surveying in the central Sierra and its results. J. E. Church, jr 43

An examination by means of Schuster's periodogram of rainfall data from long records in typical sections of the world. Dinsmore Alter. (9 figs.) 44

The criteria of reality in the periodogram. Dinsmore Alter 57

Some outstanding tornadoes. *Abstr.* Clarence J. Root 58

NOTES, ABSTRACTS, AND REVIEWS:
- Avalanche at Bingham, Utah. J. Cecil Alter 60
- Glacier water utilised in city's water supply 61
- Provisional sun-spot relative numbers, Wolfer, for 1925. *Repr* 61
- Evaporation in vegetation at different heights 61
- Warmest February at London in 156 years. *Repr* 61
- Climatic changes in western America. *Repr* 62
- Meteorological summary for southern South America, January, 1926. J. B. Navarrete 62
- Meteorological summary for Brazil, January, 1926. J. de Sampaio Ferraz 63

BIBLIOGRAPHY:
- Recent additions to the Weather Bureau library 63
- Recent papers bearing on meteorology 64

SOLAR OBSERVATIONS:
- Solar and sky radiation measurements during February, 1926 65

WEATHER OF THE MONTH

Page

WEATHER OF NORTH AMERICA AND ADJACENT OCEANS: †
- North Atlantic Ocean 66
- Table of ocean gales and storms 68
- North Pacific Ocean 69

DETAILS OF THE WEATHER IN THE UNITED STATES:
- General conditions 70
- Cyclones and anticyclones 70
- Free-air summary 70
- The weather elements 72
- Table of severe local hail and wind storms 74
- Storms and weather warnings 74
- Rivers and floods 76
- Great Lakes levels 77
- Effect of weather on crops and farming operations 78

TABLES:
- Climatological tables 79
- Canadian data 83

CHARTS

Serial number

I. Tracks of centers of anticyclonic areas 12
II. Tracks of centers of cyclonic areas 13
III. Departure (°F.) of mean temperature from the normal 14
IV. Total precipitation, inches 15
V. Percentage of clear sky between sunrise and sunset 16
VI. Isobars at sea level and isotherms at surface; prevailing winds 17
VII. Total snowfall, inches 18
VIII—XIII. Weather maps of North Atlantic Ocean, February 1–6, 1926 19–24

† In marine separate.

MONTHLY WEATHER REVIEW

Editor, ALFRED J. HENRY   Assistant Editor, BURTON M. VARNEY

Vol. 54, No. 2
W. B. No. 888   FEBRUARY, 1926   CLOSED APRIL 3, 1926
ISSUED MAY 8, 1926

PAPERS ON THE RELATION OF THE ATMOSPHERE TO HUMAN COMFORT

By C. DORNO

[Davos, Switzerland]

In a manner much to be commended Dr. C. F. Brooks has published in the MONTHLY WEATHER REVIEW, October, 1925, **53**: 423–437, a paper under this heading having as its object the characterization of the climate of a given place by the relations of the total influences upon man's feeling of certain weather types prevalent at that place.

Meteorology has achieved much in recent decades in the service of agriculture, shipping, and air travel; on the other hand, it has not many successes to record in its direct relationship to man in health and disease, to his feeling, and to hygiene. The explanation lies in the difficulty involved in the task, for, in addition to the great variety of climates, depending chiefly on geographic latitude, altitude above sea level, soil covering, and the complexity of each resulting from the many weather elements superposed in their effects, the influence of the ecological factor is effective to a far greater degree in man than in plants (agriculture), in that with the progress of civilization man has been able more and more to withdraw himself from the direct influences of the weather by means of housing and clothing—through the influence; that is, of the "private climate" which he can create and which is considerably at variance with the local climate as measured by meteorology. Racial peculiarities present further difficulties and the problem which Doctor Brooks has set is, to be sure, rendered most complicated by the circumstance that with man, in contrast to the method most generally employed in botany, we must individualize according to constitution, antecedents, etc. Neither in legal practice nor in intellectual theory has it been possible to construct a "normal human being," and even fundamental laws which appear to establish relationships to normal man, such as, *e. g.*, Rubner's law of surface (i. e., basal metabolism proportional to human body surface, or indeed to surface of all warm-blooded animals) have probably never proved more than roughly approximate values which in certain conditions are found to be not applicable (*1*).

Shall we, then, in view of the knowledge of these great difficulties, abandon the attempt to create a science of climate in its relation to human comfort, or, as I have termed it, a "specifically medical climatology?" (2). (Still better, perhaps, would be, "physiological climatology.") Nothing were more absurd, for no climatology assumes a simpler form than one brought into reference to warm-blooded animals with their constant temperature. If to this end we employ our present meteorological tables in their usual form, as George F. Howe and E. S. Nichols and J. Elmer Switzer (*loc. cit.*) have ingeniously done, unanimously stressing the importance of the frequency data for characteristic weather types, then we do not calculate, we merely estimate, on the basis of the experiences gained from our environment, and the conclusions derived vary accordingly.[1]

In this respect the Davos Climatological Congress was quite instructive (the programme appeared in the MONTHLY WEATHER REVIEW, Volume 53, No. 7, 1925, pages 312–313, and the papers read are just being published), for it reflected as in a mirror in the most varied manner the views upon climatic characteristics and climatic effects held by the representatives of climatological science—kaleidoscopically varied biological and medical scientists from the most northern and southern continental and littoral, plain and Alpine regions. The sun is a friend to one, to the other an enemy; one prefers

[1] We may perhaps here refer to the table of factors for the determination of the index of comfortableness of the weather (a conception first introduced by Cleveland Abbe) compiled by Z. von Dalmady, of Budapest,* as a result of medical experience with middle-European patients needing a protective climate:

I		III		IV			V	
Temperature		Wind (empir. degrees)		Cloudiness			Difference of insolation °C.	
				1/10	t°<19°C.	t°>19°C.		
−3.1– 0.0	−5	0	+2	0, 1, 2	+2	0	10	+1
0.1– 6.0	−4	1	+1	3, 4	+1	0	20	+2
6.1–11.0	−3	2	0	5, 6	0	0	30	+3
11.1–15.0	−2	3	−1	7, 8	−1	0	40	+4
15.1–19.0	−1	4	−2	9, 10	−2	−1	50	+5
19.1–22.0	0	5	−3	----	----	----	----	----
22.1–26.0	+1	----	----	----	----	----	----	----
26.1–30.0	+2	----	----	----	----	----	----	----
30.1–35.0	+3	----	----	----	----	----	----	----
35.1–40.0	+4	----	----	----	----	----	----	----

II

Atmospheric humidity

%	6°C.	6.1–11.0°C.	11.1–15.0 °C.	15.1–19.0 °C.	19.1–22.0 °C.	22.1–26.0 °C.	26.1–30.0 °C.	30.1 °C.
– 45	+2	+1	+2	+1	0	0	0	0
46– 65	0	0	+1	0	0	0	+1	+1
66– 85	−1	−1	0	0	0	+1	+2	+3
86–100	−2	−2	−1	0	+1	+2	+4	+6

The addition of the factors gives the index. The zero-value corresponds to pleasant, indifferently-tempered weather at wind-velocity Beaufort 2.

Index >0 signifies favorable weather.

Index −1 to −4 signifies less pleasant weather.

Index <−4 signifies unserviceable.

This scale also fails when applied to the calm Alpine valley of middle geographic latitude, as has been shown by reckoning (similarly to that mentioned above). The effect of the cold is greatly over estimated, that of the solar radiation and the dryness of the air underestimated.

* Zeitschrift für die gesamte physikalische Therapie, Vol. 30, No. 5, 1925, p. 223.

91587—26†——1

wind, the other avoids it, etc., each according to the effect upon the human species which he has observed in the conditions of his environment.

If we wish to pass from "estimation" to "calculation," then we must refer uniformly to income and loss at 36.5° C. our body temperature, as is done by C. F. Brooks (*loc. cit.*, p. 424), and also to the income and discharge of moisture. Heat and water constitute the basis of all life. This might be attempted with a certain degree of success by calculation from the meteorological tables at present in use. These while of course primarily and universally serviceable for the purpose of meteorological science *par excellence*, are by no means yet employable for a physiological climatology, for they only place the different elements side by side and with reference to very different standards. Thus atmospheric temperature and atmospheric humidity both set out from the zero-point given by the change in the aggregate states of water, a fundamental meteorological value, and in the measurement most frequently undertaken, viz., that of the relative humidity, the latter is referred to the former; but in the case of wind the standard which serves is the velocity of its propagation, which in no way expresses anything with reference to its cooling effect,

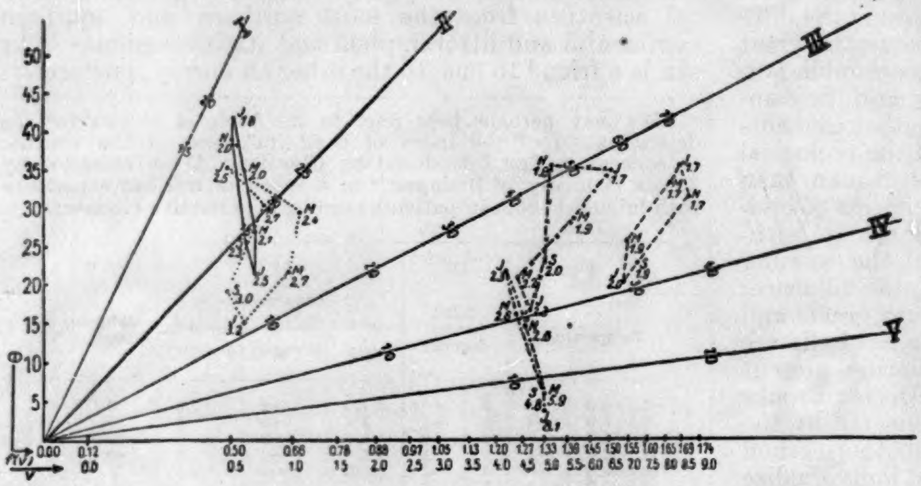


FIG. 1.—Specifical-physiological climogram

i. e., its relation to temperature and humidity. Radiation absorbed and emitted are denoted by the heat absorbed and emitted by an absolutely black, totally absorbing surface, which in nature is nonexistent—and here again the radiation is made referable to the atmospheric temperature.

When we wish to make climatologically correct use of these data for the determination of income and outgo of heat and moisture, whether in the organic or inorganic world, cross-calculations to the temperature of the body under observation are inevitably necessary, which can be very different from that of the atmosphere, either from heat-production as in warm-blooded animals or from the influences of radiation and conduction. Thus, for example, a relative humidity of 100 per cent for 0° C. atmospheric temperature is equivalent to 50 per cent in the case of a wall heated by radiation to 10° C. at the same time, and to only 10 per cent for the human subject with his body temperature of 36.5° C., and an emitted radiation of 0.200 calorie at 0° atmospheric temperature is in the instances under consideration equivalent to 0.265 or 0.488 calorie; and in the same manner evaporation (loss of humidity) and cooling (heat loss) assume quite enormously different values. The great advantage, however, gained for physiological climatology in these cross-calculations is that the point of reference continually remains the same, while for the instance of a wall subject to radiation (or, substitute a plant or cold-blooded animal) it continually fluctuates. If, in the tables to be compiled for a "physiological climatology" we uniformly substitute 0° *phys.* (similar to the common abbreviation *abs.*) for 36.5° C., and then for temperature, relative humidity, and loss by radiation refer uniformly to this zero point, the tables will become much more serviceable and impressive. One need but compare in the case of Davos the statement for humidity and emitted radiation, as is at present customary, with the corresponding "physiological" values, viz: annual mean relative humidity over 54 years 77 per cent (at 2.6° C. atmospheric temperature), corresponding to a physiological humidity of 9 per cent only; mean emitted radiation of the black surface during winter nights at atmospheric temperature of −6° C., 0.219 calorie, as against a physiological radiation of 0.543 calorie.[3] These physiological figures show at once the climatic nature of the dry, cool, calm Alpine valley with its pure, light atmospheric mantle. As I demonstrated in 1920 (*3*), instead of the figures for the physiological humidity, impressive as they are, it is, perhaps, more advantageous to substitute the "physiological saturation-deficit," for this directly expresses the amount of water in grams that each cubic meter of respired air is capable of removing from the body.

Except in extreme cases of very high atmospheric temperature, when we wish to deduce by calculation from its velocity the cooling and drying effect of the wind upon a body at 36.5° C., special assumptions, particularly with regard to the size and surface-nature of the body, become necessary, also somewhat intricate formulæ which need not here be discussed. It is obviously possible, however, to derive by calculation from the present tables the physiological heat income and loss and the physiological humidity income and loss referred to a uniform standard, but it is certainly very troublesome.

And here our medical brethren have indicated to us the road, as we are bound to acknowledge, for their endeavours to formulate the sum of climatic influences according to a uniform standard of "cooling power" dates back a century, and the subject has concerned the medical profession in almost every civilized country. Leonard Hill taught us about eight years ago, it will be remembered, how to obtain this quantity very simply, by means of his kata thermometer, whose revolutionary effect was due precisely to its simplicity. He also provided us with the formulæ according to which the cooling power measured in the shade is dependent upon atmospheric temperature, humidity, and wind, from which, conversely, we may calculate the cooling power from these three quantities; as an anemometer, indeed, the kata thermometer even surpasses all known wind-measuring instruments for delicate air-currents approach-

[3] Radiation for −6° following Stefan's law 0.386
−effective radiation 0.219

Radiation of the atmosphere 0.167
Radiation for 36.5° following Stefan's law 0.710

Radiation of man 0.543

ing 0.25 meter per second (Rubner's "sensiblen Luftströme"), to which our cutaneous nerves are sensitive to a distinct and unpleasant degree. This achievement alone assures the instrument a permanent existence. Recently Paul Weiss (*4*), employing the old empirical formula of the technician for ascertaining the coefficient of thermal conductivity, has made very careful investigations resulting in Leonard Hill's formulæ for the dry kata thermometer being confirmed.

If we plot this readily obtained quantity of the cooling power in a system of coordinates in which the ordinate is the difference between body temperature and atmospheric temperature, and the abscissa the function of the wind velocity (according to Hill's formula)—as was done by me in 1922 for five very different climates (*5*)—we obtain clear pictures not only of the total effect of the meteorological factors, but also of the single effects of the principal factors, viz, temperature, wind, humidity—the last from the quotients of the wet and dry cooling power adjoining the month initials. The product of the co-ordinates of each point represents the cooling power; all the values along the thicker middle line are influenced by wind and temperature in the same manner, in the values lying above the middle line the influence of temperature predominates, in those below it that of the wind; ratio $\frac{\text{influence of wind}}{\text{influence of temperature}}$ along line I is ½, on line II it is 1 : 1, on line III, 2 : 1, on line IV, 4 : 1, on line V, 8 : 1.

It is clear at first glance that from their position with regard to the middle lines, Lugano and Davos are protected from the wind, the other places exposed to it, and that the wind influence increases from winter to summer at Lugano, Davos, and Assouan, while on the other hand it diminishes at Borkum and Potsdam. From the position relative to the neighboring figures for the cooling power, it is seen that Potsdam and Borkum are for human beings much "colder" than the other places—colder in the true sense of the word, for this is expressed alone by the cooling power and not by the atmospheric temperature, which is but one among several factors in the cooling—and that protected Lugano does not differ very markedly from Davos with the latter's very low atmospheric temperature. A somewhat closer inspection shows that the annual amplitudes for Davos and Lugano are small and differ little from one another, but that those of Potsdam and Borkum are large, while at Assouan, which passed beyond line *V* notwithstanding the strong wind, in July the cooling power only attains 4.7, while in January it reaches the same values as at Davos.

The figures attached to the month initials indicate that, in all places without exception and in spite of their great climatic differences, the ratio $\frac{\text{cooling wet}}{\text{cooling dry}}$ increases with increasing temperature from winter to summer; that is the reason why God has endowed us with sweat glands. It is of importance to note that the increase of this ratio takes place contrary to the increase of atmospheric humidity, contrary to the decrease, therefore, of the physiological saturation-deficit. Here again the decisive climatic factor is not the amount of humidity in the atmosphere, but the wind, and it more than compensates for the influence of humidity, not merely when its strength increases, but as the examples of Potsdam and Borkum show, when it loses in strength from winter to summer. The annual amplitudes of the ratio $\frac{\text{cooling wet}}{\text{cooling dry}}$ resemble each other at every place, unless extreme aridity is associated with great increase of temperature as in a desert climate; *thus only in extreme conditions is the humidity of the atmosphere decisive as a climatic factor.* The absolute value of the ratio $\frac{\text{cooling wet}}{\text{cooling dry}}$ is lowest, of course, at the seashore and it gradually increases inland and toward high altitudes with cold atmosphere, and more rapidly toward the warm air of the south.

The diagram shows at the same time in a quite general form that with low atmospheric temperatures (quantity Θ) an increase of wind velocity gives rise to a far greater cooling than with high atmospheric temperature, and that when the air is slightly in motion a small increase of wind increases the cooling to a far greater extent than in a strong wind.

Just as here the annual course at different places is represented comparatively in a climogram, so it would be possible to combine the daily course over the various months at one place into a climogram, and thus supply in diagrammatic form an answer to almost any question which might arise as to the climate of a particular place.

All values refer to temperatures in the shade; data with regard to radiation had to be given in an extra table.

Let us acknowledge the immense advance which the simple determination of the cooling power has represented for a "physiological climatology"—toward which we must by all means strive—and thoroughly utilize it. By far the most important value is the cooling power as indicated by the dry kata thermometer. From the measurements (*6*) carried out at Davos in 1921–1922 on the basis of systematic thrice-daily determinations of both rate of cooling and temperature of the skin of the cheek, there emerges a far-reaching proportionality between the difference, 36.5° C. minus the temperature of skin of cheek (i. e., the cooling of the skin of cheek) and the cooling power shown by the dry kata, viz: the cooling value for the cheek is obtainable in ° C. by halving the cooling power shown by the kata thermometer. This proportionality is found both in the average and in the single measurements at all times of day and year. This may be taken to indicate that the skin temperature well expresses the combined thermal effect of the single weather factors upon the organism, and this need not appear astonishing, for most probably there is a parallelism between the feeling of temperature and the functions of the nervous regulating-mechanism. The same nerves, which transmit stimuli for the feeling of temperature may be concerned, also at least partly reflex, in providing the vaso-motor regulating influence, thus regulating the amount of blood in the skin and the loss of heat therefrom.

On continuing the measurements of the skin surface (*7*) it was found that precisely the skin of the cheek, which Leonard Hill had also selected, delivers the most suitable temperature for comparison, better than the skin of the forehead as frequently employed. The skin temperature is, of course, not by any means a universally valid measure of the total loss of heat, being merely an indication like the kata index which is proportional to it. This indication, however, is of the utmost importance to "physiological climatology" and "human comfort" in that it largely corresponds with personal feeling. This has been demonstrated by Leonard Hill and his collaborators as well as by Weiss (*loc. cit*) and still earlier by Reichenbach and Heymann (*Zeitschrift für Hygiene*) by exact experiments in closed rooms, and it agrees with the Davos and other findings in the open air. So far as hitherto known the temperature of the cheek and the kata index (including the wet) fail us only in extremes of humidity, particularly in the combination of very high temperature with very great humidity; through sweat-

ing an entirely new mechanism comes into function which is decisive for the heat discharge, and no further conclusions as to feeling can then be drawn from the measurements of heat quantities.

To me it would seem that "physiological climatology" should find its most important field in the accumulation of the "dry kata" values, in checking up the extent to which these run parallel with the temperatures of the cheek and hence with feeling, clothing being adequate and external conditions as varied as possible (including those meteorological elements against which it is possible to afford protection, such as wind and radiation), and in fixing the laws of deviation if such laws exist. Should the existence of a most far reaching parallelism, except in extreme conditions, between the physical instrument and the physiological cooling indicated by the skin be confirmed, as may be hoped, then the mean and extreme values, the daily and annual course, the frequency, and the hourly, daily and annual sums of the cooling power indicated by the dry kata, should constitute the basis of "physiological climatology." To these values corresponds very largely the tax levied by a climate upon body heat production, which ultimately must be met by the heart's work. The very important therapeutical conceptions of the stimulative and the protective climates, with all their subdivisions, would then be defined by this single numerical category. In truth, the determination of human comfort is not the sole, nor even the chief, end of "physiological climatology."

Manifestly the same degree of cooling power can result in manifold ways from the cooperation of the various meteorological elements, and it is not by any means unimportant whether it is produced, for example, by cool, dry air in combination with a calm, or by warm, damp air associated with wind. In this respect, however, the tables in use to-day, as they stand, provide definite information, but their full value is realized only when they are considered in combination, in terms of a fundamental unit.[3] They then serve for an analysis which is quite simple in comparison with the very complicated synthesis on p. 39. It could be considered, perhaps, whether the tables of the cooling power should be supplemented by indices showing the wind velocity; by these indices the second important quantity, atmospheric temperature, would then be shown indirectly with sufficient clearness.

The task of meteorology within its own field in relation to physiology and hygiene would thus, I think, have been fully accomplished; for special studies of basal metabolism and its increase by the agencies of nourishment, clothing, and work, belong exclusively to the realm of physiology and hygiene.

Lefévre's formula for the determination of human comfort, as employed by Doctor Brooks and by Donnelly, fails under such conditions of calm—as obtain here in Davos chiefly during the winter for many days in succession; and it gives quite inadequate consideration to the solar radiation. The physiological effect of this, indeed, is not exhausted by setting down an average number of calories. Apart from the great fluctuation of intensity in the daily and annual course, according to altitude above sea level, water vapor content, and dust content of the atmosphere, the solar radiation is effective to very different depths in the body (*a*), varying with its spectral composition, while temperatures at the skin surface and deeper parts run by no means parallel—the latter again, being very rarely dependent on the wind velocity. The annual variation in the spectral composition of the Davos sun has, moreover, been shown to coincide with the variations of temperature at about a depth of 2.5 centimeters under the skin (which, moreover, reaches a maximum of 40° C, with essentially lower skin temperature) in that the spring sunshine, richest in deeply-penetrating infrared rays, exercises the most powerful deep-seated effects. Much was said at the Davos congress[4] on the subject of the physiological and therapeutical deep-seated effects of radiation in its relationship to the wave-length.

In conclusion, the question may be briefly discussed as to whether any improvement is possible and necessary in the methods of measurement employed at the present day, particularly by Leonard Hill and his coworkers.

A. *The kata thermometer*

(1) In the nonhomogeneous alcohol thermometer the adjustment between vessel-wall and liquid is necessarily delayed owing to the difference of conductivity, and convection currents then give rise to inequalities. A homogeneous substance would be preferable. (2) The exchange of heat by conduction with the air is also retarded owing to the poor conductivity of the glass. (3) The cylindrical form possesses disadvantages by comparison with the spherical, as in the latter all points at the surface are equidistant from the center of mass and are equally oriented against the factors of heat withdrawal which are effective on all sides. (4) An increase in the size of the measuring body is desirable in that it would more resemble the dimensions to which it is intended to be applied viz, the human body. (5) As the single elements governing the cooling power are as a rule each separately subject to continual fluctuation, as is therefore the cooling power also, it would appear to be most desirable to be able to make a registration which would supplement these individual values.

The Davos Frigorimeter (*9*) answers all these requirements.

A black, nearly solid copper ball 7.5 centimeters in diameter, into which is fitted a small control-thermometer, is mounted on a metal plate by means of a metal tube about 1 centimeter in diameter and 8 centimeters high, and provided with a conducting cable and a contact plug. Separately from these a powerful clock about 12 centimeters in diameter and 11 centimeters high is mounted on a wooden board together with a contact plug and a relay and two resistance coils. Another cable is linked to the electric supply by a contact plug and joined to the relay and the clock. The ratio between the time read off at the clock and the time which has elapsed during the intervals between the readings, multiplied by the factor provided with the instrument, gives the cooling power in thousandths of gram calories per square centimeter per second. A triple range of measurement which suffices for all requirements is provided for and rendered available by a switch system. Repeated, mutually checking,

[3] The value of the cooling power is again very instructively shown under the extreme conditions of a wind-protected Alpine valley in middle geographic latitudes. What physician can send a patient to Davos on the strength of the individual values presented in the meteorologcial tables?

The wintry cold, the large fluctuations of temperature, the high relative humidity, would appear to exclude the idea entirely, yet these are in strong contrast to the therapeutic experience of 65 years and to the conclusive measurement of the cooling power. Notwithstanding the low temperatures the cooling power is found to be probably less than at any place north of the Alps and not much greater than in the protected health resorts of the Swiss and north Italian lakes, and in spite of the considerable fluctuations of temperature it is more uniform in its daily and yearly course than perhaps in any place not subtropical or tropical. This is due to the extremely little motion of the air and to its really extraordinary dryness together with the powerful insolation (which in the method of measurement of the cooling power after Leonard Hill in use hitherto, has not been determined, because owing to the short duration of the period of observation the effect of radiation in the instrument can not attain full expression, the measurement being undertaken therefore only in the shade.).

[4] The congress books are published by Messers, Benno Schwabe & Co., Bale, Switzerland.

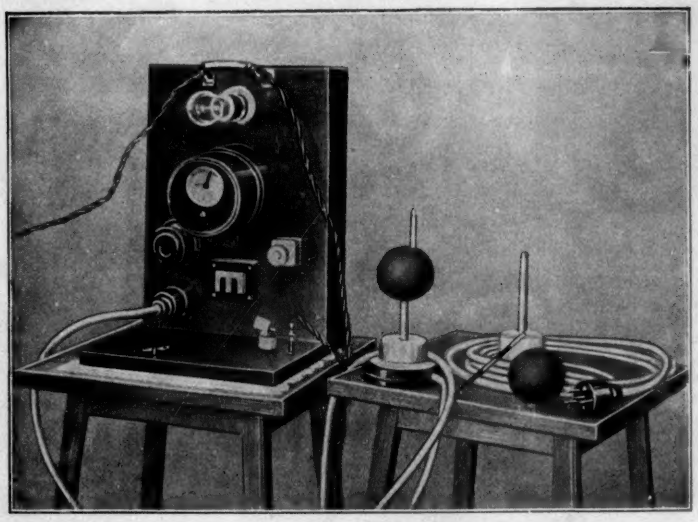


FIG. 2.—The Davos Frigorimeter

single measurements can be made within two or three minutes; summation for longer periods, such as, morning, afternoon and night, is obtainable by a single reading of the clock and a simple multiplication.

B. *The skin thermometer*

This never gives such precise values as those obtained by the thermo-electric method, and in a powerful wind it is unreliable. A thermo-element has been employed at Davos consisting of copper and constantan of which one soldered joint is immersed in a thermos bottle filled with oil (air is also sufficient, but not water) and is in direct connection with the mercury bulb of a sensitive thermometer, which projects from the mouth of the bottle and may be read off there, while the other soldered joint is movable and can be transferred to the surface of the body to be measured. A simple but important provision is that this second narrow and thin soldered joint is extended over a tiny, narrow piece of cork, which hinders radiation and owing to its low conductivity does not remove any heat. Mounted on the same board and in connection with the thermos bottle is a galvanometer with a resistance of 1 Ohm only and a sensitiveness of 10^6, rendering the whole very transportable. With this outfit it is possible to measure on an average to a tenth of a degree centigrade with precision.

LITERATURE CITED

(*1*) Benedict, Francis G.
1924. Bulletin société scientifique d'hygiène alimentaire, XII, 8/9, p. 62.

(*2*) Meteorol. Zeitschr., 1922, no. 11, pp. 344–347.

(*3*) Dorno, C.
1920. Klimatologie im Dienste der Medizin. Vieweg Tagesfragen, vol. 50.

(*4*) Archiv für Hygiene, vol. 96, 1925.

(*5*) Dorno, C.
1922. Geeignete Klimadarstellungen. Zeitschr. für physikalische und diätetische Therapie, XXVI, 401 *et seq.*

(*6*) Ibid., *loc. cit.*

(*7*) Loewy, and Dorno.
1925. Ueber Haut und Korpertemperaturen und ihre Beeinflussung durch physikalische Reize. Strahlentherapie, XX, 411 *et seq.*

(*8*) Ibid., *loc. cit.*

(*9*) Meteorol. Zeitschr., 1925, no. 2, p. 57–60.
Zeitschr. für die gesamte physikalische Therapie, vol. 29, no. 6, 1925, p. 230–235.

SIXTEEN YEARS OF SNOW-SURVEYING IN THE CENTRAL SIERRA AND ITS RESULTS

By J. E. Church, Jr.

[In charge Nevada Cooperative Snow Surveys, Reno, Nev.]

Snow-surveying under the percentage system as conducted by the Mount Rose Observatory is based upon two fundamental facts: (1) The approximate uniformity of the snow cover over wide areas and (2) the intimate relationship in the western mountains between winter snow fall and the spring-summer flow.

During the 16 years of field work, only two disturbing factors of major importance have been found, viz, (1) premature melting of the snow cover at lower levels and (2) deficiency in normal precipitation during April–July. The former can be determined and measured by means of low level snow courses at the time of the annual snow survey April 1. The probability of the latter and its results can usually be determined by May 1 or at the latest by May 15.

The maximum shrinkage in stream flow due to lack of April–July precipitation is 25 per cent of normal for rivers and 50 per cent for Lake Tahoe. However, the usual revision for precipitation has not exceeded 10 per cent for streams and 20 per cent for Tahoe. A few revisions have been made after the season was over. However, these were based upon principles noticed then for the first time but applicable at the beginning of the season. These revisions are distinguished from those for April–July precipitation by being placed in parentheses.

Six basins are included in the series and are situated on both sides of the range. One of these, the Tahoe, consisting mainly of a lake, is greatly affected by precipitation upon its surface. Another, the Carson, has large diversions above its point of gaging. A third, the Mokelumne, possesses only crest snow survey stations and depends for its outpost estimates upon measurements in the South Yuba Basin, which is separated from it by the wide American Basin. Yet out of 54 forecasts for the entire six basins, 29 forecasts were within 10 per cent of the actual run-off while 14 were within 20 per cent. In the remaining 11, the maximum divergence between snow cover and run-off was only 30.4 per cent.

The following table on comparison of snow cover and run-off will give details and serve as a record of seasonal net snow cover and run-off in the Central Sierra since the snow surveys were established in 1909–10:

Comparison of snow cover April 1 or revised forecast May 1-15 and run-off April-July (per cent of normal)

N. B. Until 1918-19 unrevised snow cover April 1 is used as a forecast. Those revised May 1-15 marked by an R placed before number. Those revised on basis of new data after season was over are followed by Rev., and new estimate in parentheses.

Season	East slope of Sierra								West slope of Sierra			
	Truckee (exclusive of Tahoe), 351,200 A. F.		Lake Tahoe, rise 1.66 feet, 204,180 A. F.		Carson (but subject to heavy diversions), 251,476 A. F. (N. B.—Courses few)		West Walker, 199,366 A. F. (N. B.—Snow courses mostly in East Walker)		South Yuba, 205,442 A. F. (Heads against Truckee)		Mokelumne, 461,486 A. F. (Heads against Carson)	
	Forecast	Run-off	Forecast	Run-off	Forecast	Run-off	Forecast	Run-off	Forecast	Run-off	Forecast	Run-off
1909-10	No forecast until 1921-22 except that for adjoining basin of Lake Tahoe.	65.9	82.7	61.5	No forecast until 1917-18, but compare adjoining Tahoe for similarity.	64.1	No forecast until 1918-19, but notice usual similarity to Tahoe and Carson, adjoining basins to north.	96.6	No snow survey until 1915-16. Then only one wind-swept course until 1918-19.	68.4	Only survey course at Blue Lakes at Crest and interpolation from S. Yuba. Note close correspondence between run-off S. Yuba and Mokelumne though the American intervenes.	68.1
1910-11		190.9	170.4	172.3		176.7		150.6		119.3		120.6
1911-12		52.2	49.7	64.5		42.4		56.2		68.3		50.2
1912-13		56.2	58.2	69.3		57.2		50.9		70.1		65.2
1913-14		144.2	153.8	150.6		162.9		-------		99.5		129.3
1914-15	----------	92.7	88.2	89.8	----------	93.3		-------		109.8		122.9
1915-16	----------	130.9	151.9 (101.9 Rev.)	99.4	----------	125.7	----------	119.9	168.4 (148.4 Rev.)	122.2		123.9
1916-17	----------	101.5	117.4	125.9	----------	128.7	----------	106.9	120.7	106.0		115.1
1917-18	----------	57.6	96.2 (56.2 Rev.)	53.6	100.2 (80.2 Rev.)	55.8	----------	81.9	85.4 (65.4 Rev.)	69.0	100.2 estimated (80.2 Rev.)	76.2
1918-19	----------	77.1	R 80.8	72.9	R 83.9	66.6	R 83.0	69.9	R 99.2	80.8	R 83.9	81.6
1919-20	----------	51.2	R 51.3	56.0	R 70.0	39.6	R 74.8	70.0	R 67.5	57.1	R 68.0	72.4
1920-21	R 96.0	73.7	R 80.0	90.4	R 103.0	78.6	R 102.0	92.4	R 109.0	101.9	R 103.6	98.4
1921-22	R 135.0	117.6	R 121.3	124.1	R 124.8	121.2	R 149.3	121.2	R 141.8	121.3	R 130.0	126.9
1922-23	R 99.4	82.0	R 95.1	94.0	R 85.9	80.2	R 92.0 approximately.	85.3	R 98.6	[1] 99.2	R 81.0 approximately.	[1] 74.7
1923-24	R 15.4	15.0	R −1.9	−3.0	R 26.0	8.9	R 32.6	23.9	R 25.1	28.5	R 32.5	24.1
1924-25	64.2	55.4	80.2	101.2	77.9	75.2	85.1	88.7	62.9 (75.7 Rev.)	104.0	62.9 (83.0 Rev.)	95.7

[1] Data for July lacking, making thus only a 3-month run-off. The inclusion of July would decrease the divergence in the case of the Mokelumne.

AN EXAMINATION BY MEANS OF SCHUSTER'S PERIODOGRAM OF RAINFALL DATA FROM LONG RECORDS IN TYPICAL SECTIONS OF THE WORLD

[This paper supplements that by the same author in Monthly Weather Review, Oct. 1924]

By DINSMORE ALTER

[University of Kansas, Lawrence, Kans., Dec. 18, 1925 [1]]

SYNOPSIS

This is the ninth of a series of papers on the rainfall of the world, and the second on the application of Schuster's Periodogram. In the last application of this method, published in the Monthly Weather Review of October, 1924, periods longer than nine years were investigated. In this one, periods are examined between nine and two and one-sixth years. In the next paper, which is already mostly computed, still shorter periods will be considered. The aim of these investigations is to examine typical sections systematically, so that all facts concerning rainfall periodicities, which are inherently possible in data at the present time, may be established. It is believed by the author that this question requires such a method as the periodogram, through which periodicities and probabilities are shown, entirely free from the personal bias which must affect the judgment when almost any other method is used. At present, it is his belief, the great need is for such a careful examination of data, rather than for theorizing regarding causes. It is only through thus establishing accurate quantitative relationships that the theories regarding causes can be given the sound footing which they require. Naturally a knowledge of causes is the final goal of all research, but any short cut to theories regarding them is too dangerous to use.

The following summarizes the principal results obtained so far.

(*a*) Rainfall periods certainly do exist.

(*b*) There is, in all sections of the world examined, a very marked bias toward harmonics of the sun-spot period, too much so to be merely accidental.

(*c*) It is impossible to say at present whether these periods are constant or varying in length, however, the bulk of the evidence favors the former.

(*d*) It would be too unsafe to make agricultural predictions on the basis of results so far obtained. However, some sections of the world indicate quite strongly that this may be possible in the future.

(*e*) The more nearly a climate approaches a pure marine the more nearly does its periodogram give us definite results.

[1] Since sending the manuscript for publication, an excellent article by Sir Gilbert T. Walker on the periodogram has appeared in No. 216 of the Quarterly Journal of the Royal Meteorological Society. Our conclusions regarding the strength and limitations of the method parallel each other very closely although in general his treatment is the more elegant.—*D. A.*

SCHUSTER'S PERIODOGRAM METHOD OF FINDING HIDDEN PERIODICITIES

Schuster's method is the most careful analytical net which has been devised to investigate the existence of periodicities, hidden from casual inspection by means of accidental errors or by the presence of multiple periodicities. Various attempts have been made to use shorter methods of analysis but all these seem unsafe to the writer, some because real periods may be overlooked, others because they permit accidental periodicities to appear real.

Little summary of the method is necessary here, merely a statement of the equations being sufficient. Given data $q_1 \ldots q_n$, assume any period P_j times the datum interval. Let φ_i be the phase angle for the datum q_i, so that $\varphi_{i+1} - \varphi_i = \frac{2\pi}{P}$. $(\varphi_1 = 0)$

Define:

$$A_j \equiv \sum_1^n q_i \cos \varphi_i; \quad B_j \equiv \sum_1^n q_i \sin \varphi_i$$

$$I_j \equiv \frac{A_j^2 + B_j^2}{n}; \quad \tan \Phi_j \equiv \frac{B_j}{A_j}$$

where Φ_j is the phase of the best sine curve of period P_j at the instant of observation of q_1, and I_j is proportional to the square of the amplitude of this curve. Periods P_j are chosen of lengths such that there is little phase divergence between adjoining ones during the stretch of data, and I_j is computed for each. A curve is then drawn with P's as abscissæ and I's as ordinates.

Usually a quantity $H_j = I_j/I_{mean}$ is plotted instead of I_j. Schuster determined the mean I by measurement of the area under the curve. In one of my papers (*1f*) I have computed this mean value by the equation

$$I_m = 1.099\epsilon^2$$

where ϵ is the probable error of one datum under the assumption that all their deviations are accidental. If the *order* of the deviations of the q's is not accidental, we have peaks in the periodogram higher than would be expected from the theory of probabilities. The frequency of distribution of such peaks, under the law of accidental grouping, is e^{-H}. It is obvious that peaks higher than would be expected from error distribution, will raise the mean height of I, if we have only a limited number of values of q, or a short stretch of the periodogram. The computed value of I_m is that which we would have obtained by measurement, if we had had many data and had used a long stretch of periodogram. It is, therefore, not only more convenient but also more accurate to use in computing probabilities. After publication of the above equation, I found a more convenient form for computation:

$$I_m = \frac{\sum_1^n \sigma_i^2}{2(n-1)}$$

where σ_i is the deviation of q_i from the mean q.

As we use smaller and smaller values of P, we find that the amplitude of a computed period is less than it would have been had we used shorter datum intervals and, therefore, a larger P for the same period. However, it is easy to reduce a computed I to what we would have obtained from the shorter intervals, by means of the equation (*1f*)

$$I^1 = I\frac{(x-y)^2}{4\sin^2\frac{1}{2}(x-y)}$$

where x is the phase of q_i and y that of q_{i+1}, expressed in radians. It is almost needless to remark that computations of probability must be made from an H which has not been multiplied by this factor. Nevertheless, the factor has some real value, since it gives us the most probable values of the intensities and amplitudes of the best sine curves of periods P_j and enables us, thus, to compare their effect on the data. This factor is given as column F of Table 5. Probably it would have been better to have plotted the periodograms after multiplication by F; however, I have used the original values for this in order that the graphs may conform to long established custom.

With periods of three times the datum interval or less, F begins to get large and accordingly the ratio of accidental error to intensity of any real period of a given amplitude becomes greater. For these reasons any such real periodicity will be displaced more from its true value, both in length and intensity, than will longer periods of the same amplitude. It is, therefore, impossible to demand as good an agreement as would be expected of longer periodicities. In this paper periodicities have been investigated, using yearly datum intervals, for the whole range between nine and two and a sixth years. However in the next paper, now more than half finished, half yearly datum intervals will be used. That paper will cover the range two and a half to one and a twelfth years, thus overlapping the most inaccurate part of the present periodograms.

Limitations and powers of the method.—There are a few of these which it may be well to mention, although probably almost all of them are well known to everyone who has studied the method. Most of them have been discussed in detail in various publications.

1. No matter how small amplitudes of real periods may be, they can be shown definitely to be real, if we have enough data. In oral discussion of a paper read recently, the objection that this is not true was raised against the method. Schuster's method yields nothing to any other method in showing small real periodicities. The objection has arisen through the fact that some other methods do not show clearly enough the lack of evidence in favor of these periods.

2. Periods of large amplitude will have both their length and intensity most accurately shown, since the greater they are, the less is the ratio of accidental errors to them. For this reason if we have any grounds, either theoretical or statistical, to suspect a given set of periods, as for instance harmonics of the sun-spot period, we will demand of the highest peaks a very much greater coincidence with these harmonics than for lower peaks, even though these also be high enough to indicate a good possibility of reality.

3. If two stretches of data are investigated, the longer including and being a continuation of the shorter, intensities of periods should remain the same, on the average for the two stretches, if they be accidental but should be larger for the longer stretch, if they be real. This refers, of course, to periodograms plotted from the ratio H_j.

4. In determining reality of periods, not only the intensity, but also the length of the period with respect to some other plausibly related phenomenon should be considered. For example, if in this rainfall investigation, peaks of medium heights, nearly at harmonics of the sun-spot period were to be found, it would be legitimate to regard them as more probably real than we would regard those of the same intensities but whose lengths of periods had no special significance. However, it is mainly a matter of judgment and personal opinion what weight shall be attached to this consideration, unlike the matter of intensity for which there is an accurate mathematical probability. For this reason extreme caution must be used with this argument. It can be used merely as an additional evidence to the primary one derived from the intensity.

5. The same period, found in independent records of *any one kind of data*, is almost as strong an argument for reality as is intensity. This is especially true for chronologically different records.

6. In the preceding paper (*1d*) it was shown that the accuracy with which any period is located is less than that which would be expected from casual examination of the periodogram.

7. The expression "expectancy ratio under error law" would be more accurate to use than "probability," since the calculation of e^{-H} shows the ratio, to be expected by accident, of peaks of a given height to the number of peaks computed. *The probability, based on mere statistics, that the peak represents a real period is much less than this ratio,* Also each peak, established definitely, makes minor peaks of medium height more worthy of consideration. Although Shuster was very emphatic in stressing this point about the probabilities of reality, it seems not to have been appreciated by some.

He considers that only those peaks for which this expectancy ratio is less than one in two hundred are worthy of consideration as possibly real, when based on statistics alone. This judgment seems quite sound, although the number of points computed in the periodogram should be considered, and it will be adopted here as a criterion, except when modified by 4 and 5 above. In such cases a larger ratio may be considered as sufficient to indicate a possible real periodicity.

8. In using Schuster's periodogram there is absolutely no danger of prejudicing the solution in favor of some particular value, as has been done by other methods.

9. The method can be adapted to investigation of variable periodicities. The same limitations apply here as to other methods, although, as in 1 above, they are more obvious than in most other methods which have been applied to such cycles. In order to make a legitimate examination, the law of variation must be assumed from hypotheses other than an examination of the data. For example, it is entirely legitimate to crowd up or stretch out weather data in accordance with the apparent variations of the sun-spot period before applying analysis to them. But it would be entirely forbidden to take these equal phase intervals for the sun-spot data themselves. Also, similarly, it would be improper to look at weather fluctuations and say that when crests were far apart a period had lengthened, merely from an examination of these data themselves.

10. In computing the mean height of the curve the total data are used. Since, in order to hold approximately to complete cycles, some data are usually discarded at one end of the stretch, it would be most strictly correct to compute I_m for each point, only from the data used for that point. This would involve considerable labor for a very slight improvement in the value of H. The neglect will always lower H slightly and, therefore, merely results in probabilities of reality being actually a little greater than we have computed. Schuster discusses this near the bottom of page 74 of the reference (*2c*) above.

11. For short periods, such as investigated in this paper, it is no longer permissible to abbreviate the work by repeating or averaging a month every now and then to get fractions of years, as was done in the last paper. The work is enormously increased by the fact that the mean phase of any year must be accurately computed and that only in comparatively few cases will any phase angle be repeated more than twice during the stretch. Instead of a sum or a mean being multiplied by sine, and cosine, each value of q_i must be so multiplied. However, if we assign the same number of years to the stretches of data from different parts of the world, the phase angles, sines, and cosigns, once determined, may be used for all. In this case there were 73 years of data for the Pacific coast of the United States, and this number was used for all other sections, except the Punjab where only 62 years are available.

EXAMINATION OF DATA FOR VARIABLE PERIOD

An hypothesis which has been discussed somewhat in recent years is that weather periods or cycles do exist and that they stretch out or close up so as to keep in step with the variations of the sun-spot period. For years this period was considered to be 11⅛ years, which is the *mean* visible period between successive maxima or minima of the number of sun spots. Recent work by Hale (*3*) at the Mount Wilson Observatory shows that the period of variation of magnetic polarity is exactly double this and that it is better to consider the mean period as being 22.25 years.

In the earliest papers of this series, a short period was examined on the hypothesis of a forced phase agreement between rainfall and sun spots. There the datum intervals were months and it was difficult to make the proper table for expanding or contracting the number of data to keep a constant number of phase steps between successive sun-spot maxima or minima. Here, using yearly data, the problem is much simpler. Table 4 shows the years to be repeated or averaged to force such a relationship. Within narrow limits, this choice of years is arbitrary. However, a rule of spacing as uniformly as possible leaves little choice. The method is, of course, but an approximation; nevertheless, if the weather cycles exist and do thus change their period, the periodogram derived from the data thus adjusted should show higher peaks than from the unadjusted. This adjustment gives exactly 22 datum intervals to the sun-spot period, instead of the average of 22¼ as for the unadjusted. The writer was surprised to find how little difference there is in the tables of adjusted and unadjusted data since 1850, the year for which the 73 data for these investigations usually begin. Twenty of the years agree exactly in both the unadjusted and adjusted tables, 47 differ by but one place, and only 6 by as much as two places. It is evident that there will, in general, be a great similarity between the periodograms and that it will be very difficult to tell whether periods approximately constant in length or changing with the apparent sun-spot variation are the more probable. If the earlier sun-spot data, which show large deviations from the mean period, can be accepted as approximately accurate, then the preceding 73 years, for which we have data from Northern Europe, should tell us much about this question.

THE DATA USED IN THIS PAPER

(*a*) *Pacific coast of the United States*.—These are identical with Table 5 of the preceding paper and, therefore, will not be reproduced here.

(*b*) *Northern Europe*.—Many new data have been added so that they are given *in toto* as Table 1.

(*b*) *The Punjab of India*.—These data are identical with Table 6 of the former paper, except for the addition of the years 1919–1924. Table 2 shows these later years only.

(*d*) *Eastern United States*.—In the main, these are the same as Table 4 of that paper. New England stations have been added. Table 3 shows only these additional stations and the means of these with the stations of the previous paper.

The Pacific coast of the United States.—The results for this section are shown in the first columns of Table 5 and in Figure 1. Three periods stand out above all others in the unadjusted periodogram. First is one of $H=8.98$ at $P=2.469$ years; second $H=7.42$ at 5.38 years, and third is $H=7.17$ at 4.42. The computed expectancy ratios for these peaks follow. For the largest value of H, one out of every 7,950 should be of this height by mere accident. In the periodogram there are 86 computed points, with two of this height. It would be, therefore, entirely improbable that we would obtain this peak by accident. For the next two peaks the ratios are 1 to 1,660 and 1 to 1,280. If the sequence of deviations on the Pacific coast is but accidental, one would be much surprised to obtain any peaks as high as this, and much more surprised to find three. One-ninth the sun-spot period is 2.472 years,

an agreement with the highest peak more perfect than one could possibly expect, indeed far within the accuracy with which the peak can be located. One-quarter of the sun-spot period is 5.56 years, differing from the second of the observed peaks by 0.18 of a year. The computed uncertainty in the position of the peak is much larger than for the shorter period, having increased both because of the lesser number of cycles in the 73 years' data and also because of the lesser phase change in one year. It is 0.14 of a year, approximately equal to the discrepancy. Moreover, the steepness of the two sides of the peak indicates that, if more points had been computed, the crest would have fallen to the right of its present position, somewhere between 5.40 and 5.45, giving a smaller discrepancy. One-fifth the sun-spot period is 4.45 years, 1.11 years less than the fourth harmonic. Therefore, the peak agrees with the harmonic to better than one-sixth the interval between harmonics, an agreement closer than would have been expected by accident, but not impossibly accidental. The third peak is at 4.42 years, which differs from its harmonic by the almost negligible quantity of 0.03 of a year. Therefore, in this periodogram we have three peaks so high that we would expect none of them by accident, two of them in almost perfect coincidence with sun-spot harmonics and the third closer than we would expect through chance.

Two other peaks are found just at the limit of the Schuster criterion, and because of the presence of the very high ones, they become worthy of some notice. The higher is at 2.25 years, differing from the tenth harmonic by 0.02 of a year. The next is at 3.17 years, as perfect an agreement with the seventh harmonic as the solution permits. The lowest of the highest six peaks is at 6.83 years and is the first peak to diverge seriously from the sun-spot harmonics. Each of the highest five peaks fall remarkably close to the harmonics of the sun-spot period.

Examination of the adjusted periodogram shows the expectancy ratio of the highest peak to be one in 5,500. The peaks, although still high, average lower and the coincidence with sun-spot harmonics is lacking. Therefore, so far as we can tell from the available data of this section, constant periodicities, at least so far as length of period is concerned, are the more probable. Some of sort periodicity almost undoubtedly exists and there is a quite probable relationship to the sun-spot period. This section has the purest marine climate of any of those investigated.

Northern Europe and the British Isles.—In this section, which is next nearest to being a pure marine climate, 146 years of data have been used. The first pair of periodograms have been computed from the years 1777–1849 and the later from 1850–1922.

The 1777–1849 unadjusted periodogram shows but two peaks of much interest, however, one of these is far the highest peak found for any section. For it, $H=16.95$ and it is found at 2.449 years, almost exactly where the highest peak was found for later years on the Pacific coast. The expectancy ratio of peaks of this height is one in 22,400,000. Independently of the fact that it is at one of the sun-spot harmonics and of the fact that it agrees almost perfectly with the highest peak of a different section and from a later stretch of years, there is little question that this peak is not accidental. A period equal to one-ninth the 22.25 year sun-spot period actually did exist in northern European rainfall during these years.

The second highest peak has an expectancy ratio of 1 in 1,600. It falls at 4.17 years, which is 0.28 of a year less than the fifth harmonic, which was found in the data of the Pacific coast. The third peak is much lower with an expectancy ratio of one in 250. Its position resembles somewhat that of the seventh harmonic, also found in Pacific Coast data, but there is little to depend on, either from its magnitude or position. Of course, if it actually be a real peak, it will, due to its small magnitude, be subject to greater displacement than higher ones.

When we turn to the adjusted data we find once more that the peaks are lower, although much higher than accident would place them. The expectancy ratio of the highest is one in 4,370, of the second highest one in 1,280 and of the third highest is one in 200. Again we find that the adjusted peaks bear no relationship to the sun-spot period. This is extremely important evidence in favor of nonvarying periodicities, for it was during this epoch that the sun-spot period appeared to diverge most from constancy. Although, for the latter stretches of data we would expect the false hypothesis to show nearly as well as the true, here as we would expect, we do find the differences of the two periodograms to be very marked.

So far all our evidence has been extremely favorable to an hypothesis of constant periodicities (at least so far as the length of the period is concerned) which occupy certain harmonics of the sun-spot period. However, the data from Northern Europe for the years 1850–1922 tell a different story. The unadjusted shows, it is true, three peaks higher than we would expect from accident, but they are low compared to those of the preceding periodograms. The expectancy ratios are one in 420, in 340 and in 220. The two highest of these fall very nearly at sun-spot harmonics, the higher missing the fourth harmonic, also found in the Pacific coast, by only 0.06 of a year, which is practically perfect agreement for periods of this length, and the next missing the seventh harmonic by 0.05 of a year.

When we turn to the adjusted period we find one peak with an expectancy ratio of one in 1870, and two others of about one in 200 each. Of these three only one, and that one of the two lowest, falls near a sun-spot harmonic. That one is very close to the sixth.

This reversal of previous results is surprising. However, an analysis of Table 1 gives us some indication of what has happened. In the data of the later years, a number of new stations have been added, as they began to make records, in an attempt to eliminate, as far as possible, accidental errors and the effects of local storms. Several of these were in Germany, two of them being possibly too far south from the north coast to be true marine rainfall. It is a natural result of the prevailing westerlies, that we can go farther inland for marine type stations on west coasts than on others, especially the east and north. The principal effect of these inland stations comes in the later data, so that, if there be a phase difference between marine and continental stations, these records would cut down peaks instead of reinforcing them.

If we will choose carefully as pure a marine type of climate as is possible in this section, the ninth harmonic, which has disappeared, should reappear if this be the true explanation. A periodogram was computed, therefore, for the years 1850–1922 from the data of the British Isles. Possibly it would have been better to include the records of western France, of Sweden, of Denmark, of the Netherlands, etc., which had already been used in the early curve. If I ever repeat this section I shall do this, especially for a computation of a short periodogram

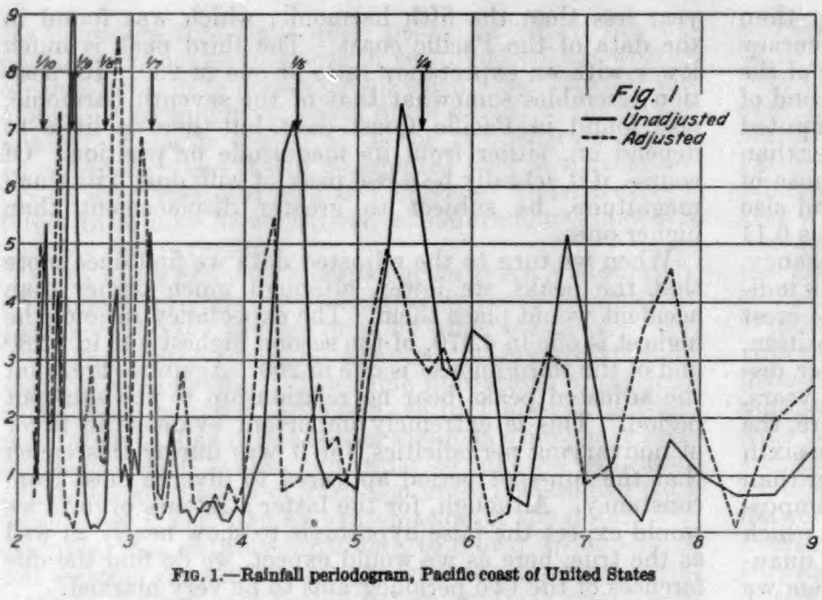


FIG. 1.—Rainfall periodogram, Pacific coast of United States

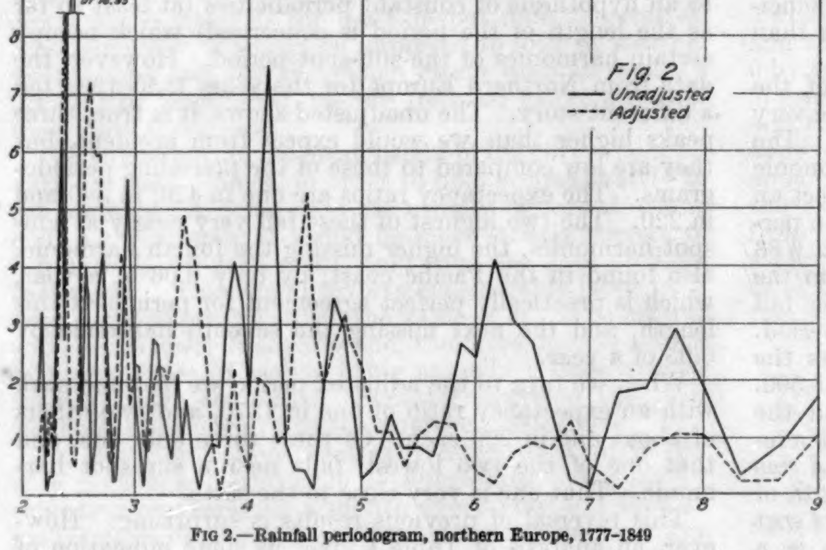


FIG 2.—Rainfall periodogram, northern Europe, 1777-1849

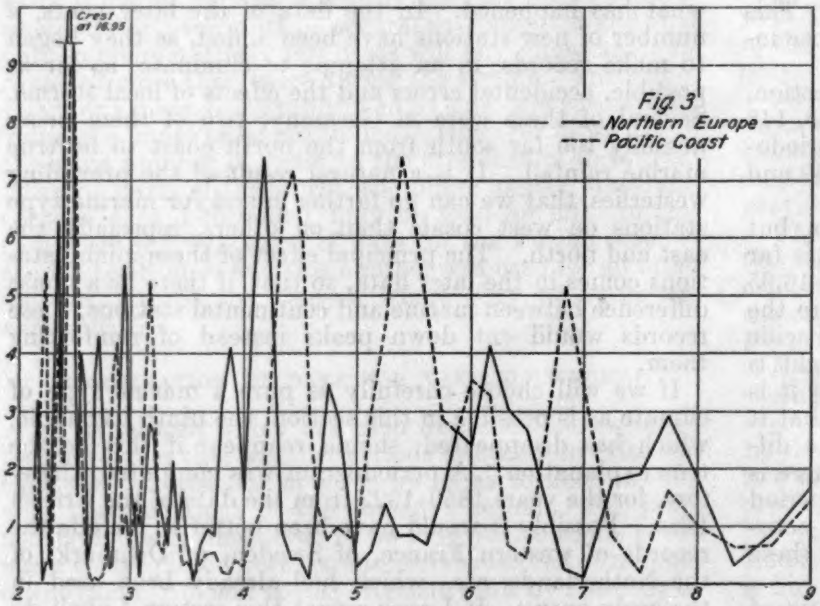


FIG. 3.—Rainfall periodogram, northern Europe, 1777-1849, and Pacific coast of United States, 1850-1922

in the neighborhood of the ninth harmonic. This special periodogram for the British Isles was carried through only for the unadjusted data. A considerable improvement was found. Peaks exist of $H=6.97$ at $P=2.84$ years, of 6.81 at 3.17 years, with a secondary of the latter of $H=6.24$ at 3.38 years, and of 6.30 at $P=4.25$ years. There are two minor peaks $H=5.18$ and 4.54, respectively, the latter at 2.42 years, 0.05 of a year from the true position of the missing ninth harmonic. These three highest peaks are all higher than any in the previous unadjusted periodogram and are surpassed by but one peak of the adjusted periodogram. The expectancy ratios are one in 1,300, in 900, and in 600. They hold rather closely to the eighth, seventh, and fifth harmonics, especially to the seventh, for which the agreement is perfect.

It is evident that the exclusion of the inland data has made a considerable improvement, but the closeness of the agreement between the periodograms of 1777–1849 for Northern Europe and of 1850–1922 for the British Isles, which are a large part of the former, can show best only by an examination of the superimposed curves. Quite apparently the main differences are in magnitude only, and we have a very similar "spectrum" from the two epochs. This point will be discussed later. These superimposed curves are shown as Figure 7. Figure 6 shows the two unadjusted Northern Europe periodograms and Figure 3 compares the early Northern Europe with the Pacific Coast.

The Punjab of India.—We have one section which is almost as pure a continental type as is to be found. This section is The Punjab, a thousand miles inland and with light winter and heavy summer monsoons. Unfortunately there are only 62 years of data available. This fact is certain to give us smaller values of H, if the peaks be real. If accidental, their mean heights should be unaffected. Tentatively we shall study peaks lower than we demanded for the other sections.

In the unadjusted periodogram we find for the highest peak $H=4.78$ at $P=2.78$, which is exactly the eighth harmonic. The expectancy ratio of this peak is one in 120. For the second highest peak $H-4.49$ at $P=7.5$, with the steepness indicating the true crest between the computed points of 7¼ and 7½. This is exactly at the third harmonic. The third highest peak is $H=3.60$ for $P=3.17$, almost exactly at the seventh harmonic. Although not as strong evidence of reality as for other sections, because of the low heights of these peaks, this series of agreements is among the prettiest things seen in the investigation.

In this section we find that the adjusted peaks are somewhat higher than the others, with $H=5.38$, 5.35, 5.07 and 4.81. The expectancy ratio of the highest peak is one in 215. This peak does not match at all with the harmonics. The second highest at $P=2.25$ matches the tenth fairly well. The third peak at $P=3.75$ is very close to one-sixth of 22. The fourth

peak is at 7¼ years, very near the third harmonic. On the whole we find, for this section, that the evidence is slightly in favor of the variable period, although not nearly so strongly as is the reverse in the case of the Pacific Coast and Northern Europe.

Eastern United States.—If this section were to be computed again, I would choose only a small part of it, probably New England. The same error was made as in the case of Northern Europe. Data are included from a large region, extending from New England to St. Paul, then to New Orleans and east to Florida. On the whole, it tends to be continental in rainfall.

The highest peak on the unadjusted curve is a symmetrically shaped one, $H=5.73$ at $P=7.5$, the third harmonic. Its expectancy ratio is one in 310. The next highest peak is $H=5.63$ at $P=4.75$. This is one of two adjoining peaks, the other being $H=4.40$ at $P=4.33$. The curve does not get down to normal between them. Neither is at a harmonic, for they straddle $P=4.45$, the fifth harmonic. The only other point worthy of mention is $H=4.50$ at $P=3.17$, the seventh harmonic, which has been so persistent in various parts of the world.

The adjusted curve gives us but one peak, a high one, $H=7.78$ at $P=7.25$, the third harmonic of 22. This one high peak, with expectancy ratio one in 2,400, makes this periodogram very striking. However, when all is balanced it seems that the evidence from this section scarcely favors one hypothesis more than the other. Probably it is slightly in favor of the variable period.

THE BIAS OF THE UNADJUSTED DATA TOWARD SUN-SPOT HARMONICS

We have constantly seen the agreement of peaks of the unadjusted periodograms with harmonics of the sun-spot period. In each section, without a single exception, the highest peak is almost exactly at one of the sun-spot harmonics. This bias continues, in general, to the second and even to the third highest peaks. The following tabulation exhibits clearly how unusual this coincidence actually is.

Section	Highest, H	Peak, P	Harmonic	Derived sun-spot period
				Years
Pacific Coast	8.98	2.47	9	22.23
Old Northern Europe	16.95	2.45	9	22.05
New Northern Europe	6.04	5.62	4	22.48
British Isles	6.97	2.84	8	22.72
The Punjab	4.78	2.78	8	22.24
Eastern United States	5.73	7.50	3	22.50
Mean				22.37

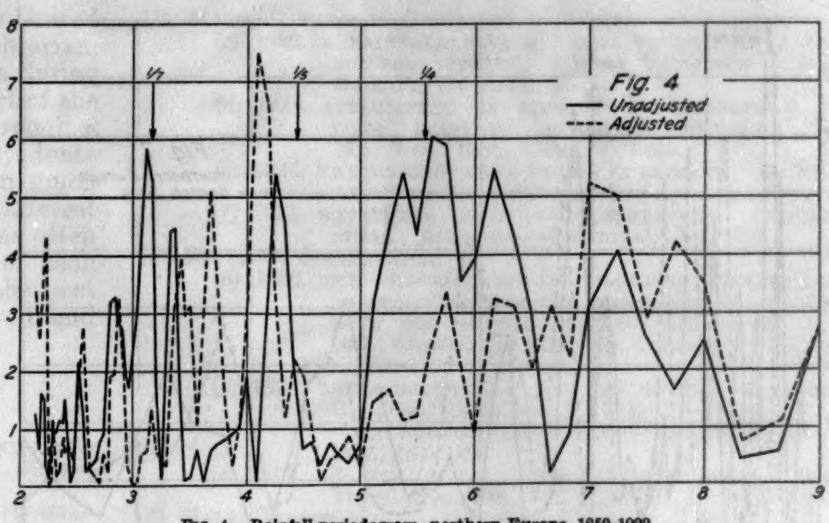


FIG. 4.—Rainfall periodogram, northern Europe, 1850-1922

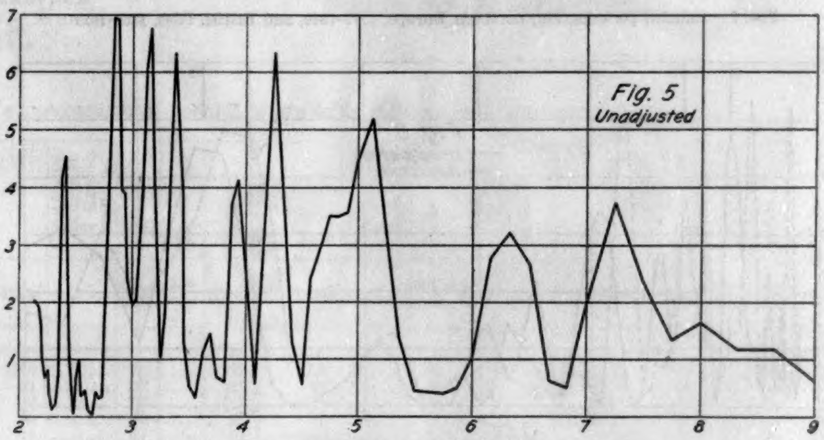


FIG. 5.—Rainfall periodogram, British Isles, 1850-1922

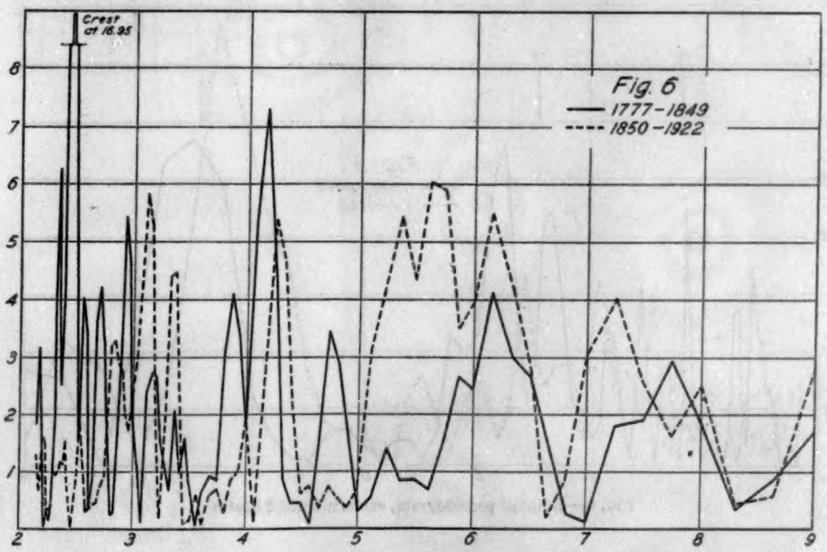


FIG. 6.—Rainfall periodogram, northern Europe, 1777-1849 and 1850-1922

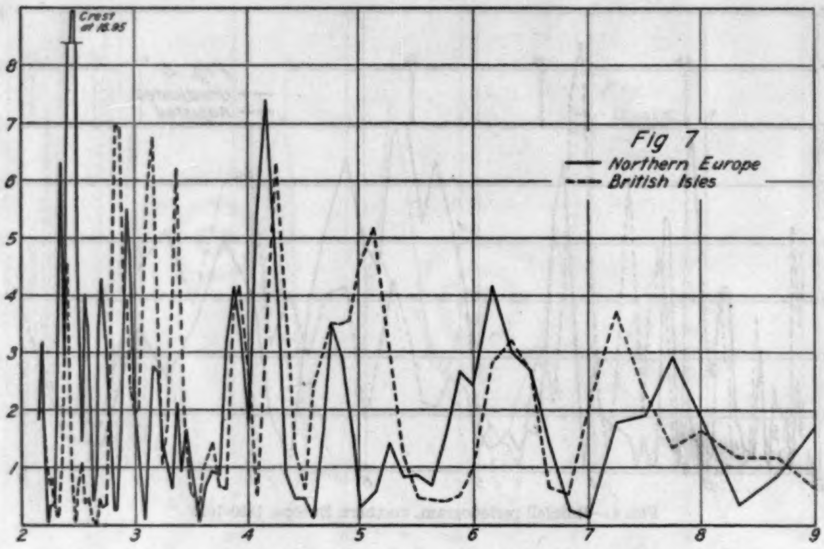


FIG. 7.—Rainfall periodogram, northern Europe, 1777-1849, and British Isles, 1850-1922

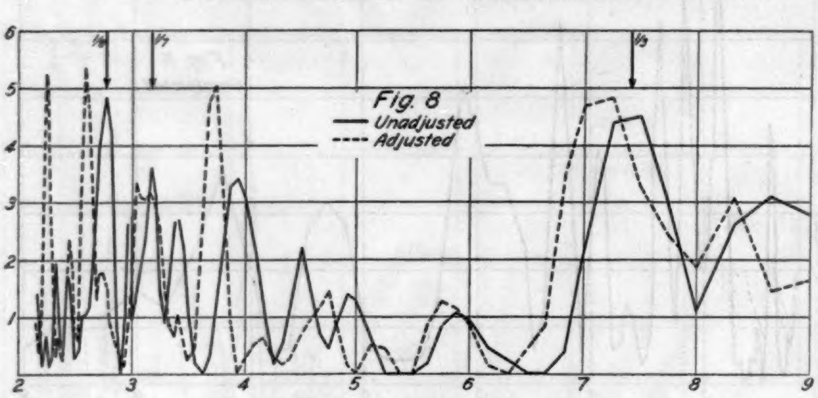


FIG. 8.—Rainfall periodogram of the Punjab

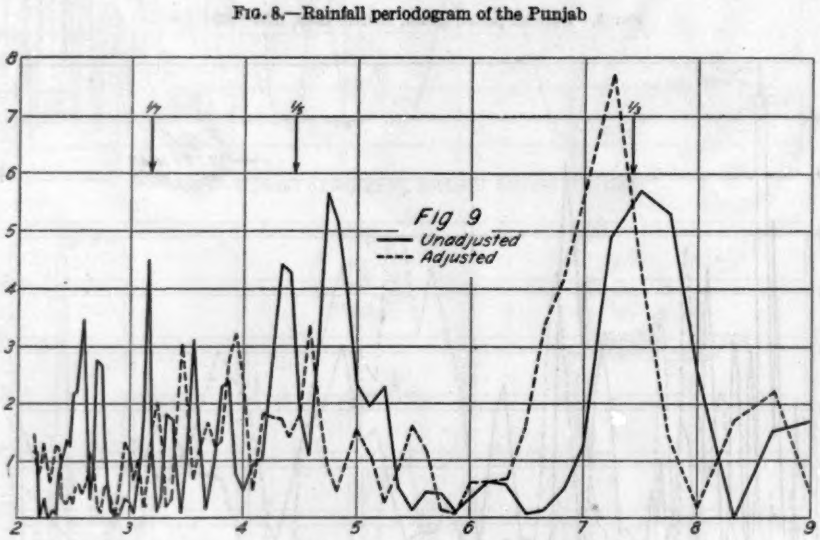


FIG. 9.—Rainfall periodogram, eastern United States

The sun-spot period as computed from the rainfall data disagrees by only 0.12 years from the value obtained from the spots themselves. Its probable error is 0.07 of a year. Regardless of the interpretation which one may put on the periods found here, it seems impossible that the relationships between sun-spot and rainfall periods can be accidental.

RECAPITULATION AND CONCLUSIONS

(*a*) The higher peaks found in the periodograms can not be due merely to accident.

(*b*) On account of the little difference between the supposedly variable sun-spot period and a constant one, during the last three-quarters of a century, it is impossible to determine definitely whether the periods are fixed or variable, but the bulk of the evidence favors the fixed periods.

(*c*) The periods are, for some reason, closely related to the sun-spot period. This paper is statistical and does not enter into causes.

(*d*) The effects seem most pronounced for marine climate and especially so for the pure marine climate of our Pacific coast. This is exactly the result found several years ago in an investigation of a short period (*1c*).

(*e*) Periods of practically constant length, but possibly with varying amplitude, seem most probable. For an identical conclusion regarding sun spots, by Schuster, see pages 89–95 of (*2c*) in the bibliography.

(*f*) Nothing has yet been found of sufficient accuracy to use as a basis for long range agricultural forecasts, although the results distinctly encourage the hope that this may be found in the future, at least for the Pacific coast of the United States and perhaps for the Punjab.

(*g*) For the same reasons that these periods gave very much more definite results than the longer ones of the previous periodogram investigation, it can be expected that the next paper on still shorter periods will be even more definite.

(*h*) There has been for many years much theorizing regarding causes of supposed relationships. Although the end of all research is to find causes, it seems to the writer that our present need is to establish statistically and accurately the quantitative relationships between solar and terrestial phenomena, in order that there may be a firm basis for the hypotheses of the future.

I wish to thank Professor Marvin, Chief of the United States Weather Bureau, and Professor Talman, librarian, for giving me full access to all stacks and records during three weeks spent at the bureau a year ago. Part of the computations for this paper have been made through a grant from the research committee of the Graduate School of the University of Kansas. Also I am much indebted to Professor Kester for his continued interest in the problem and the sound advice which he has often given. He has carefully studied even details of each paper published by me on this subject during the past five years and many points have been improved and added through his suggestions.

LITERATURE CITED

(1) ALTER, DINSMORE:

(a) 1921. A POSSIBLE RAINFALL PERIOD EQUAL TO ONE-NINTH THE SUN-SPOT PERIOD. Mo. Wea. Rev., February 1921.

(b) 1920. CONTINUATION OF INVESTIGATION OF A POSSIBLE RAINFALL PERIOD EQUAL TO ONE-NINTH THE SUN-SPOT PERIOD AND APPLICATION OF MARVIN'S PERIODOCRITE TO RAINFALL PERIODICITY. Kansas University Science Bulletin, Vol. XIII, Nos. 8 and 9.

(1) ALTER, DINSMORE—Continued.

(c) 1922. A RAINFALL PERIOD EQUAL TO ONE-NINTH THE SUN-SPOT PERIOD. Kansas University Science Bulletin, Vol XIII, No. 11.

(d) 1924. APPLICATION OF SCHUSTER'S PERIODOGRAM TO LONG RAINFALL RECORDS, BEGINNING 1748. Mo. Wea. Rev., October, 1924.

(e) 1925. THE SIXTEEN YEAR PERIOD IN CLIMATE. Bulletin American Meteorological Society, August, 1925.

(f) 1925. EQUATIONS EXTENDING SCHUSTER'S PERIODOGRAM. Astronomical Journal, No. 850.

(2) SCHUSTER, SIR ARTHUR:

(a) 1900. THE PERIODOGRAM OF MAGNETIC DECLINATION AS OBTAINED FROM THE RECORDS OF THE GREENWICH OBSERVATORY DURING THE YEARS 1871–1895. Cambridge Phil. Soc. Trans., Vol. XVIII, p. 107.

(b) 1905. THE PERIODOGRAM AND ITS OPTICAL ANALOGY. Roy. Soc. Proc., Vol. LXVII, 136–140.
On sun-spot periodicities—Preliminary note. *Ibid.*, 141–146.

(c) 1906. ON THE PERIODICITIES OF SUN SPOTS. Phil. Trans. Roy. Soc. Vol. A, CCVI, pages 69–100.

(3) HALE, GEORGE E.:

1924. THE LAW OF SUN-SPOT POLARITY. Proc. Nat. Acad. Sciences Vol. X, pages 53–55.

TABLE 1.—*Northern European Rainfall—Yearly percentages of normal at available stations with long rainfall records*

	Compilation of data for 8 English stations	Paris	Berlin	Mean
Normal	--------	496.9 mm.	549 mm.	------
Year				
1689	--------	103	-----	103
90	--------	128	-----	128
91	--------	78	-----	78
92	--------	123	-----	123
93	--------	124	-----	124
94	--------	64	-----	64
95	--------	107	-----	107
96	--------	106	-----	106
97	--------	-----	-----	-----
98	--------	-----	-----	-----
99	--------	102	-----	102

	Compilation of data for 8 English stations	Paris	Berlin	Mean
Normal	--------	496.9 mm.	549 mm.	------
Year				
1700	--------	109	-----	109
1	--------	117	-----	117
2	--------	89	-----	89
3	--------	94	-----	94
4	--------	108	-----	108
5	--------	75	-----	75
6	--------	83	-----	83
7	--------	98	-----	98
8	--------	100	-----	100
9	--------	119	-----	119

	Compilation of data for 8 English stations	Paris	Berlin	Mean
Normal	--------	496.9 mm.	549 mm	------
Year				86
1710	--------	86	-----	137
11	--------	137	-----	115
12	--------	115	-----	112
13	--------	112	-----	81
14	--------	81	-----	95
15	--------	95	-----	78
16	--------	78	-----	96
17	--------	96	-----	72
18	--------	72	-----	56
19	--------	56	-----	

	Compilation of data for 8 English stations	Paris	Berlin	Mean
Normal	--------	496.9 mm.	549 mm.	------
Year				
1720	--------	93	-----	93
21	--------	69	-----	69
22	--------	79	-----	79
23	--------	46	-----	46
24	--------	67	-----	67
25	--------	93	-----	93
26	109	62	-----	86
27	104	74	-----	89
28	114	88	87	96
29	103	93	77	91

	Compilation of data for 8 English stations	Paris	Berlin	Mean
Normal	--------	496.9 mm.	549 mm.	
Year				
1730	86	87	121	93
31	66	55	79	63
32	96	89	90	92
33	84	42	109	78
34	118	95	100	104
35	102	75	112	96
36	111	82	77	90
37	109	86	115	103
38	73	80	81	78

TABLE 1.—*Northern European Rainfall—Yearly percentages of normal at available stations with long rainfall records*—Continued

	Compilation of data for 8 English stations	Edinburgh	Kendal	Greenwich	Chilgrave	London	Haverford West	Glengyle	Belfast	Lund	Abo	Warsaw	4 stations in Norway	Copenhagen	Utrecht	Montdidier	Paris	Lille	Brussels	Koenigsberg	Tilsit	Berlin	Danzig	Mean
Normal		25.9 in.	52.1 in.	24.7 in.	34.3 in.	25.6 in.	48.0 in.	91.8 in.	34.6 in.	17.2 in.	592.5 mm.	575 mm.	49.7 in.	22.7 in.	28.5 in.	(?)	496.9 mm.	691 mm.	742 mm.	659 mm.	661 mm.	549 mm.	546 mm.	
Year																								
1739	99																104					94	116	103
40	72																118						110	100
41	62																70						113	82
42	75																70						98	81
43	64																72						95	77
44	96																87						136	106
45	98																68						112	93
46	88																76						84	83
47	100																90						112	101
48	83									(101)							94						98	94
49	86									85							104						100	94
1750	86									91	102						114						110	101
51	117										103						126						89	109
52	90										124						100						114	107
53	87									96	103						97						97	96
54	76									89	122						75						88	90
55	83									71	126												141	105
56	100									75	120												79	94
57	93									93	101												86	93
58	84									81	94												100	90
59	81									77	125												83	92
1760	70									119	140												96	106
61	87									107	85												81	90
62	71									107	93												64	84
63	118									103	110												95	106
64	101									80													106	96
65	82									93	96												89	90
66	77									82	77												83	80
67	91									116	109												143	115
68	128									105	110												120	116
69	86									100	75												100	90
1770	108	106								110	99													106
71	70	86								104	94													88
72	111	124								117	98													112
73	113	111								99	103						119							109
74	129	117								111	77						121							111
75	123	132								114	100						107							115
76	107	101								89	74						127							100
77	89									97	99						89							94
78	102									101	126						102							108
79	83									103	76						113							94
1780	75	88								103	94						90							90
81	79									108	92						73							88
82	131									131	111						121							124
83	93									85	67						120							91
84	96									97	103					96	106							100
85	77	118								119	97					96	89							99
86	107	90								131	117					110	127							114
87	96	124								100	97					113	120							108
88	65	75	75							94	84					92	93							83
89	116	113	134							110	101					120	101							114
1790	86	106	120							113	96					96	71							98
91	105	106	125							93	114					104	81							104
92	117	143	160							130	129					116	107							129
93	86	80	104							85	91					72	67							84
94	104	111	134							91	116					83	79							103
95	84	141	111							101						90	81							101
96	83	68	87							98						81	70							81
97	106	105	117							127	115					82	105							108
98	88	87	104							122	72					71								91
99	106	102	113							116	143					102								114
1800	90	83	93							134	90					117								101
1	96	79	97							147						138								111
2	91	82	99							122						94								98
3	77	61	78							116						115								89
4	85	95	91							(115)						124	141							108
5	75	63	82							(128)						121	107							96
6	96	85	103													120	98	145						108
7	94	86	102							121						123	95	116						105
8	90	112	83							119						90	87	126						101
9	88	115	103							127						120	99	109						109
1810	100	104	80							78						90	88	96						92
11	98	126	122							96						117	120	122						114
12	97	105	91							78						131	100	94						99
13	92	78	95							95		98				113	101	90						95
14	92	86	86							61		72				85	77	69						78
15	99	84	110	83						108		85				112	91	81						95
16	107	97	94	111						109		127				146	110	103						112
17	100	114	98	108						100		102				120	114	106						107
18	102	83	99	95						103		86				113	87	79		74				92
19	99	105	90	114						98		114				123	124	114		79				106
1820	92	88	87	102						103		99				110	76	67		108	107			94
21	109	91	106	128						(111)		115		89		115	118	105		110	84			107
22	100	101	120	101						87		65		84		98	85	82		100	59			90
23	117	117	120	99						(97)		80		113		90	92	88		94	101			101
24	117	96	121	134						106		88		118		106	115	116		118	107			112
25	96	85	108	90						98		85		131		74	94	78		108	89			95
26	77	50	83	84						64		67		88		85	83	85			50			75
27	102	126	111	91						83		76		117		100	101	92			84			98
28	120	97	105	115						101		91		118		110	118	103			87			106
29	102	116	89	93						110		113		118		111	113	109			73			104
1830	111	128	111	98						120)		116		127		98	115	101			(79)			109

TABLE 1.—*Northern European Rainfall—Yearly percentages of normal at available stations with long rainfall records*—Continued

	Compilation of data for 8 English stations	Edinburgh	Kendal	Greenwich	Chilgrave	London	Haverford West	Glengyle	Belfast	Lund	Abo	Warsaw	4 stations in Norway	Copenhagen	Utrecht	Montdidier	Paris	Lille	Brussels	Koenigsberg	Tilsit	Berlin	Danzig	Mean
Normal	------	25.9 in.	52.1 in.	24.7 in.	34.3 in.	25.6 in.	48.0 in.	91.8 in.	34.6 in.	17.2 in.	592.5 mm.	575 mm.	49.7 in.	22.7 in.	28.5 in.	(?)	496.9 mm.	691 mm.	742 mm.	659 mm.	661 mm.	549 mm.	546 mm.	
Year																								
1831	108	95	118	107	------	------	------	------	------	(117)	------	68	------	101	------	100	106	95	------	------	81	------	------	99
32	98	90	95	74	------	------	------	------	------	(98)	------	89	------	71	------	80	92	88	------	------	95	------	------	88
33	106	81	106	96	------	------	------	------	------	(120)	------	212	------	131	------	68	101	98	103	------	77	------	------	108
34	90	84	125	81	96	------	------	------	------	98	------	95	------	90	------	80	83	72	68	------	90	------	------	89
35	99	97	107	103	90	------	------	------	------	84	------	------	------	88	------	105	88	85	83	------	70	------	------	92
36	118	127	123	113	119	------	------	------	------	93	------	77	------	119	------	118	123	115	112	------	116	------	------	113
37	87	103	93	88	79	------	------	------	------	86	------	102	------	81	------	111	110	102	100	------	94	------	------	95
38	90	120	88	100	89	------	------	------	------	84	------	79	------	92	------	99	92	92	81	------	95	------	------	94
39	107	90	111	125	118	------	------	------	------	77	------	120	------	82	------	120	117	109	105	------	102	------	------	106
1840	89	98	93	76	84	------	------	------	------	91	------	112	------	88	------	99	92	87	88	------	106	------	------	93
41	128	101	103	135	127	------	------	------	------	140	------	71	------	127	------	99	106	105	105	------	72	------	------	109
42	91	65	92	91	87	------	------	------	------	(78)	------	78	------	70	------	86	69	76	85	------	72	------	------	80
43	110	92	108	99	101	------	------	------	------	95	------	90	------	121	------	107	109	104	108	------	88	------	------	102
44	85	81	83	94	82	------	------	------	------	77	------	120	------	115	------	94	115	107	108	------	109	------	------	98
45	97	103	102	90	90	------	------	------	------	113	------	89	------	123	------	104	117	112	109	------	79	------	------	102
46	108	122	101	102	101	------	------	------	------	81	------	70	------	92	------	98	114	92	85	------	83	------	------	96
47	90	87	100	71	76	------	------	------	------	73	------	97	------	86	------	114	87	74	82	------	90	------	------	87
48	130	118	108	122	131	------	------	------	------	118	------	93	------	108	------	98	116	109	107	94	74	111	------	109
49	98	86	92	96	96	------	------	------	------	99	------	106	------	106	93	95	120	99	92	104	119	78	------	99
1850	91	79	114	79	94	------	------	------	------	85	------	153	------	102	114	106	113	107	113	111	109	115	------	105
51	88	88	91	95	76	------	------	------	------	92	------	147	------	102	96	82	94	100	104	122	105	113	111	100
52	138	122	126	138	148	------	------	------	------	146	------	82	------	119	135	122	120	135	121	90	122	123	77	121
53	101	99	76	121	111	------	------	------	------	75	------	135	------	86	108	100	91	104	89	100	112	110	107	101
54	74	81	88	77	64	------	------	------	------	90	------	126	------	98	96	111	124	102	98	107	102	115	98	97
55	88	78	66	96	84	------	------	------	------	96	------	145	------	90	100	87	69	86	90	98	104	114	107	94
56	93	110	76	94	96	------	------	------	------	81	------	93	------	102	106	104	114	98	107	96	87	86	90	96
57	97	96	74	86	91	------	------	------	------	70	------	100	------	65	67	79	99	74	62	56	66	66	------	78
58	80	94	77	72	76	------	------	------	------	68	------	119	------	71	80	79	94	64	68	49	69	136	------	81
59	102	100	93	104	100	------	------	------	------	113	------	128	------	107	95	100	110	102	102	68	90	104	------	101
1860	122	129	109	129	122	126	119	103	111	121	------	105	------	102	98	104	132	132	109	84	103	133	------	115
61	92	110	117	83	84	87	108	122	98	94	------	89	------	103	92	76	92	98	105	97	123	124	96	100
62	107	131	104	106	94	108	80	114	113	99	------	66	------	99	76	79	104	92	90	72	98	119	77	96
63	89	99	105	80	89	84	94	115	107	94	------	77	------	98	71	63	86	90	80	86	110	103	74	90
64	73	109	91	66	72	66	83	88	85	88	------	106	------	91	71	75	74	72	61	105	99	99	88	84
65	108	91	82	116	112	115	106	79	93	76	------	117	------	70	97	97	109	99	90	73	85	93	73	94
66	------	105	116	124	107	124	114	110	103	116	------	80	------	122	102	97	130	108	107	91	144	123	79	110
67	------	120	91	108	86	103	116	108	95	113	------	96	96	117	96	93	114	121	110	125	160	118	101	109
68	------	110	101	88	105	91	117	129	91	102	------	129	104	106	74	88	103	86	96	92	110	109	78	100
69	------	86	107	97	97	99	114	99	94	97	------	108	83	93	113	83	96	109	110	91	116	111	88	10
1870	------	85	83	75	80	83	83	77	87	99	------	112	70	81	94	82	84	98	91	65	85	130	85	87
71	------	104	96	90	97	98	97	98	92	85	------	115	76	84	96	100	105	102	86	95	102	104	------	96
72	------	151	133	121	126	132	145	139	129	131	------	103	106	124	112	109	133	147	123	96	103	93	108	122
73	------	109	95	95	91	89	95	104	90	109	------	100	102	105	92	87	117	86	86	83	106	90	------	97
74	------	100	106	81	85	74	106	116	101	81	------	77	101	90	90	80	85	87	85	84	90	78	96	90
75	------	94	89	113	103	111	122	99	93	78	------	98	67	90	110	89	102	95	91	81	79	115	105	96
76	------	137	100	98	103	102	111	102	116	106	------	101	72	100	92	107	105	107	111	110	108	116	106	105
77	------	138	126	111	131	110	134	140	122	108	------	86	106	119	112	121	118	121	129	94	112	115	110	117
78	------	96	84	117	97	133	113	89	84	102	------	94	77	106	103	124	127	115	141	108	121	101	119	107
79	------	110	83	127	108	132	103	95	97	97	------	100	88	102	98	110	96	110	95	94	105	104	101	103
1880	------	96	87	120	109	118	85	75	83	105	------	92	89	112	95	102	98	114	118	124	147	107	------	104
81	------	109	115	104	121	109	94	87	111	109	------	74	90	90	108	100	87	111	106	62	85	94	------	97
82	------	117	115	102	104	106	132	114	114	116	------	117	115	118	133	125	112	122	122	112	99	139	------	117
83	------	86	99	89	96	95	106	110	98	102	------	104	103	93	89	110	96	116	93	110	111	89	------	100
84	------	95	85	73	77	80	91	117	96	100	------	75	100	99	82	93	75	99	95	109	102	110	------	93
85	------	68	88	97	98	104	105	92	86	41	------	86	115	93	96	102	101	102	97	124	99	104	------	95
86	------	100	113	98	111	106	120	88	107	34	------	72	114	87	88	104	117	115	102	77	75	79	------	93
87	------	76	62	81	74	75	73	73	68	84	------	100	119	80	69	63	86	68	79	102	95	91	------	81
88	------	96	83	111	103	109	98	97	95	97	------	114	107	108	97	94	86	98	115	106	107	111	------	102
89	------	86	83	94	87	93	77	83	90	91	------	117	87	84	114	92	93	87	102	111	102	103	------	94
1890	------	103	92	89	85	83	89	104	94	144	------	84	109	97	117	99	90	111	115	117	110	95	------	101
91	------	93	103	101	121	110	106	103	92	100	92	------	113	110	92	------	104	87	89	108	106	114	142	104
92	------	86	107	90	81	88	78	98	90	93	102	------	109	92	110	------	102	93	88	97	97	66	96	93
93	------	81	107	81	79	77	74	100	75	102	96	------	100	94	98	------	88	99	89	104	96	96	90	91
94	------	109	104	109	126	109	104	111	91	109	103	------	98	100	128	------	91	174	107	77	93	93	110	107
95	------	103	92	80	103	84	81	81	96	107	85	------	96	99	100	------	84	118	105	114	107	89	117	97
96	------	90	92	91	105	92	85	83	95	108	97	------	106	92	99	------	125	84	94	84	83	93	91	94
97	------	------	105	89	109	89	106	105	103	110	98	------	109	106	97	------	105	98	101	104	111	107	78	102
98	------	------	101	76	83	69	88	122	88	128	129	------	119	120	102	------	98	83	78	111	132	98	95	101
99	------	------	95	90	87	88	88	116	101	107	117	------	102	92	97	------	87	87	88	115	98	87	92	97
1900	------	------	110	90	113	91	104	113	117	112	102	------	100	112	96	------	92	110	95	103	97	96	78	102
1	------	------	77	82	90	87	95	83	93	84	84	------	102	95	110	------	------	65	82	101	110	82	115	91
2	------	------	69	78	99	81	84	72	88	91	89	------	98	91	92	------	------	89	95	93	97	(111)	115	91
3	------	------	131	144	145	149	118	141	123	113	121	------	125	115	132	------	------	114	101	114	123	88	115	123
4	------	------	93	84	107	81	89	97	92	105	106	------	96	96	78	------	------	94	81	92	108	78	83	92
5	------	------	82	93	89	90	83	84	92	89	86	------	108	102	110	------	------	107	117	127	102	113	117	99
6	------	------	108	100	114	95	105	89	104	103	103	------	111	98	94	------	------	107	100	95	99	86	92	100
7	------	------	105	90	105	90	92	93	110	104	97	------	104	94	89	------	------	77	------	112	103	117	111	100
8	------	------	106	96	93	92	93	96	112	96	73	------	100	97	95	------	------	94	91	107	110	72	96	95
9	------	------	111	104	113	105	85	82	107	115	104	------	106	105	103	------	------	101	114	83	85	92	90	100
1910	------	------	103	114	105	99	95	97	117	120	106	------	104	114	116	------	------	131	133	96	91	108	97	108
11	------	------	104	96	106	97	104	103	103	------	86	------	106	109	89	------	------	93	100	93	82	72	93	96
12	------	------	111	101	119	109	118	116	129	------	128	------	108	118	138	------	------	113	127	120	124	93	117	117
13	------	------	89	91	104	88	111	91	109	------	92	------	86	92	98	------	------	100	108	113	136	78	137	101
14	------	------	103	96	115	101	105	104	101	------	72	------	106	103	108	------	------	------	118	114	123	107	121	106
15	------	------	88	124	130	126	103	82	106	------	102	------	81	96	122	------	------	------	123	119	113	105	145	110
16	------	------	108	121	106	133	91	105	109	------	103	------	------	123	123	------	------	------	142	119	128	101	106	115
17	------	------	95	105	93	117	87	83	104	------	97	------	------	96	107	------	------	------	114	97	102	84	80	97
18	------	------	113	115	98	116	109	105	110	------	96	------	------	98	121	------	------	------	114	74	92	105	62	102
19	------	------	84	93	112	102	89	79	100	------	96	------	------	97	101	------	------	------	------	118	119	90	111	99
1920	------	------	112	87	97	91	125	115	124	------	71	------	------	110	88	------	------	------	------	76	91	100	101	99
21	------	------	93	51	56	57	76	107	97	------	88	------	------	------	------	------	------	------	------	114	109	101	78	86
22	------	------	99	94	102	100	107	89	94	------	85	------	------	------	------	------	------	104	------	92	100	107	115	99
23	------	------	------	97	------	------	------	------	------	------	109	------	------	------	------	------	------	129	------	111	134	100	103	112
24	------	------	------	------	------	------	------	------	------	------	105	------	------	------	------	------	------	102	------	112	118	84	107	105

TABLE 2.—*The Punjab*

[Table supplementary to that published in M. W. R. Oct. 1924, p. 485]

Year	Per cent of normal	Year	Per cent of normal
1918	47	1922	71
1919	83	1923	91
1920	52	1924	90
1921	72		

TABLE 3.—*Eastern United States*

[The mean includes stations of Table 4 of Mo. Wea. Rev., October, 1924, p. 485]

Year	Boston	Lowell	New Bedford	Providence	Mean
1817			94		108
1818	98		88		89
1819	81		86		80
1820	101		87		102
1821	84		99		98
1822	62		90		74
1823	107		130		113
1824	82		102		95
1825	81		82		71
1826	94	78	119		89
1827	112	125	136		113
1828	74	91	85		87
1829	107	89	142		107
1830	98	103	140		102
1831	118	125	133		104
1832	107	128	107	89	101
1833	87	106	92	77	96
1834	91	77	96	95	85
1835	87	78	102	70	90
1836	93	86	93	86	100
1837	77	74	85	72	89
1838	97	91	83	86	95
1839	94	92	96	83	92
1840	112	93	107	93	97
1841	108	97	110	108	105
1842	89	93	85	85	98
1843	107	95	110	96	105
1844	86	86	88	79	88
1845	106	94	104	98	94
1846	69	68	75	69	101
1847	107	112	99	110	109
1848	94	102	88	92	96
1849	92	101	79	79	96
1850	123	123	136	116	115
1851	101	110	112	98	89
1852	110	103	100	87	100
1853	112	106	83	121	96
1854	104	102	116	105	95
1855	101	108	89	88	98
1856	119	102	80	93	88
1857	116	119	94	101	105
1858	120	86	95	101	104
1859	130	115	111	102	113
1860	118	113	86	87	93
1861	114	104	100	100	97
1862	140	107	94	114	104
1863	155	126	98	125	106
1864	113	92	89	83	91
1865	109	90	100	101	112
1866	116	92	87	104	98
1867	127	110	102	107	110
1868	147	116	122	121	115
1869	151	114	108	110	109
1870	137	112	102	111	102
1871	103	107	107	108	101
1872	115	107	103	110	100
1873	125	96	112	119	115
1874	97	86	107	98	103
1875	115	96	105	118	106
1876	112	109	91	114	112
1877	118	99	102	110	106
1878	150	137	109	119	117
1879	102	105	92	92	96
1880	85	85	87	94	100
1881	120	104	85	101	102
1882	100	99	90	102	103
1883	81	96	94	90	105
1884	112	113	119	110	107
1885	103	117	80	90	101
1886	96	111	108	118	102
1887	77	126	112	115	98
1888	105	143	119	144	111
1889	91	100	114	127	107
1890	89	118	134	115	110
1891	91	82	104	120	99
1892	85	103	93	85	97
1893	96	104	109	116	103
1894	84	81	99	96	92
1895	92	92	90	115	88
1896	86	100	103	104	94
1897	93	100	110	108	103
1898	114	130	136	144	109
1899	79	88	96	112	91
1900	101	126	96	108	94
1901	111	130	112	118	99
1902	78	124	98	109	100
1903	96	100	103	107	102
1904	91	96	108	107	92
1905	73	90	89	94	98
1906	93	101	93	109	100
1907	86	93	99	108	97
1908	69	75	91	96	86
1909	93	84	92	76	94
1910	65	69	82	78	85
1911	82	83	91	83	99
1912	79	86	99	87	100
1913	87	86	99	84	94
1914	78	67	84	67	86
1915	89	92	95	77	102
1916	85	97	100	78	92
1917	89	77	84	82	86
1918	79	85	71	85	88
1919	98	86	102	100	105
1920	105	107	108	101	103
1921	98	102	80	81	94
1922	94	122	80	102	99
1923	77	104	68	92	92
1924	80	91	80	76	94
Normals	43.75	41.49	46.21	44.16	

TABLE 4.—*Years to be repeated or averaged to form variable table, in forced step with sun-spot numbers*

To be repeated—			
1751	1772	1809	1840
1754	1776	1830	1868
1762	1780	1831	1885
1765	1807	1832	1920
1767			

To be averaged—	
1756–57	1814–15
1759–60	1824–25
1789–90	1827–28
1792–93	1844–45
1795–96	1850–51
1799–1800	1874–75
1801–02	1880–81
1804–05	1891–92
1811–12	1902–03

TABLE 5.—*Rainfall periodogram, 2⅙ to 9 years*

Mean P	I F	Pacific Coast 1850-1922 Unadjusted 249.7 I	H	H′	A	Pacific Coast 1850-1922 Adjusted 240.0 I	H	H′	A
9.000	1.036	362	1.45	1.50	1.23	616	2.57	2.66	1.63
8.666	1.041	170	0.68	0.71	0.84	464	1.93	2.01	1.42
8.333	1.047	168	0.67	0.70	0.84	3	0.01	0.01	0.10
8.000	1.053	251	1.01	1.06	1.03	476	1.98	2.09	1.45
7.750	1.057	404	1.62	1.71	1.31	1,105	4.60	4.87	2.21
7.500	1.061	51	0.20	0.21	0.46	841	3.51	3.73	1.94
7.250	1.065	211	0.84	0.89	0.94	293	1.22	1.30	1.14
7.000	1.070	867	3.47	3.71	1.93	199	0.83	0.89	0.94
6.833	1.074	1,286	5.15	5.53	2.35	682	2.84	3.05	1.75
6.666	1.078	633	2.54	2.74	1.66	753	3.14	3.39	1.84
6.500	1.082	113	0.45	0.49	0.70	524	2.18	2.36	1.54
6.333	1.086	167	0.67	0.73	0.85	77	0.32	0.35	0.59
6.167	1.091	820	3.28	3.58	1.89	40	0.17	0.19	0.44
6.000	1.096	877	3.51	3.84	1.96	427	1.78	1.95	1.40
5.875	1.101	656	2.63	2.90	1.70	604	2.52	2.78	1.67
5.750	1.106	714	2.86	3.16	1.78	769	3.20	3.54	1.88
5.625	1.111	1,122	4.49	4.99	2.23	658	2.74	3.04	1.74
5.500	1.116	1,566	6.27	7.00	2.64	749	3.12	3.48	1.87
5.375	1.121	1,851	7.42	8.32	2.88	1,043	4.34	4.86	2.20
5.250	1.127	1,167	4.67	5.26	2.29	1,173	4.89	5.51	2.35
5.125	1.134	772	3.09	3.51	1.87	874	3.64	4.13	2.03
5.000	1.142	179	0.72	0.82	0.91	428	1.78	2.03	1.42
4.917	1.147	217	0.87	1.00	1.00	207	0.86	0.99	0.99
4.833	1.153	241	0.97	1.12	1.06	395	1.65	1.90	1.38
4.750	1.159	191	0.77	0.89	0.95	349	1.45	1.68	1.30
4.666	1.165	313	1.25	1.46	1.21	614	2.56	2.98	1.73
4.583	1.172	718	2.88	3.37	1.84	428	1.78	2.09	1.45
4.500	1.179	1,546	6.19	7.30	2.70	216	0.90	1.06	1.03
4.416	1.187	1,790	7.17	8.50	2.92	190	0.79	0.94	0.97
4.333	1.195	1,655	6.63	7.92	2.81	169	0.70	0.84	0.92
4.250	1.204	1,064	4.26	5.13	2.27	1,309	5.45	6.56	2.56
4.167	1.213	339	1.36	1.65	1.28	1,107	4.61	5.60	2.37
4.083	1.223	227	0.91	1.11	1.06	532	2.22	2.72	1.65
4.000	1.233	71	0.28	0.35	0.59	195	0.81	1.00	1.00
3.938	1.242	103	0.41	0.51	0.70	114	0.47	0.59	0.77
3.875	1.252	37	0.15	0.19	0.44	201	0.84	1.05	1.02
3.813	1.261	47	0.19	0.24	0.49	96	0.40	0.50	0.71
3.750	1.271	128	0.51	0.64	0.80	151	0.63	0.80	0.89
3.688	1.280	125	0.50	0.64	0.80	88	0.37	0.47	0.69
3.625	1.291	94	0.38	0.49	0.70	89	0.37	0.48	0.69
3.563	1.304	30	0.12	0.16	0.40	126	0.52	0.68	0.82
3.500	1.318	99	0.39	0.52	0.72	468	1.95	2.57	1.60
3.459	1.327	77	0.31	0.41	0.64	669	2.79	3.70	1.92
4.416	1.336	252	1.01	1.35	1.16	451	1.88	2.51	1.59
3.375	1.346	449	1.80	2.42	1.56	431	1.80	2.42	1.56
3.333	1.356	299	1.20	1.63	1.28	101	0.42	0.57	0.75
3.292	1.367	132	0.53	0.72	0.85	48	0.20	0.27	0.52
3.250	1.379	169	0.68	0.94	0.97	55	0.23	0.32	0.57
3.208	1.391	897	3.59	5.00	2.24	185	0.77	1.07	1.03
3.167	1.404	1303	5.22	7.33	2.70	671	2.80	3.93	1.98
3.125	1.417	833	3.34	4.73	2.17	1438	5.99	8.48	2.91
3.083	1.431	245	0.98	1.40	1.18	1648	6.87	9.83	3.14
3.042	1.446	350	1.40	2.02	1.42	1014	4.22	6.10	2.47
3.000	1.462	153	0.61	0.89	0.94	260	1.08	1.58	1.26
2.969	1.475	291	1.17	1.73	1.32	401	1.67	2.46	1.57
2.938	1.488	216	0.87	1.29	1.14	941	3.92	5.83	2.41
2.906	1.501	633	2.54	3.81	1.95	1833	7.63	11.47	3.39
2.875	1.515	1054	4.22	6.40	2.53	2070	8.62	13.05	3.61
2.843	1.529	919	3.68	5.62	2.37	1823	7.59	11.60	3.41
2.813	1.544	443	1.78	2.75	1.66	677	2.82	4.35	2.09

Mean P	Northern Europe 1777-1849 Unadjusted 54.24 I	H	H′	A	Northern Europe 1777-1849 Adjusted 42.47 I	H	H′	A	Northern Europe 1850-1922 Unadjusted 42.72 I	H	H′	A	Northern Europe 1850-1922 Adjusted 39.56 I	H	H′	A
9.000	92	1.70	1.76	1.33	45	1.06	1.10	1.05	118	2.76	2.86	1.69	110	2.78	2.88	1.70
8.666	47	0.87	0.91	0.95	12	0.28	0.29	0.54	25	0.58	0.60	0.77	44	1.11	1.16	1.08
8.333	19	0.35	0.37	0.75	12	0.28	0.29	0.54	19	0.44	0.46	0.68	30	0.76	0.80	0.90
8.000	101	1.86	1.96	1.39	45	1.06	1.11	1.05	107	2.50	2.63	1.62	136	3.44	3.62	1.90
7.750	158	2.91	3.07	1.75	46	1.08	1.14	1.07	69	1.62	1.71	1.31	167	4.22	4.46	2.11
7.500	103	1.90	2.02	1.42	35	0.82	0.87	0.93	108	2.53	2.69	1.64	112	2.83	3.00	1.73
7.250	97	1.79	1.91	1.38	5	0.12	0.13	0.36	172	4.03	4.30	2.07	197	4.98	5.31	2.30
7.000	6	0.11	0.12	0.35	25	0.59	0.63	0.79	131	3.06	3.28	1.81	207	5.23	5.60	2.37
6.833	14	0.26	0.28	0.53	55	1.30	1.40	1.18	38	0.89	0.96	0.98	87	2.20	2.37	1.54
6.666	77	1.42	1.53	1.24	35	0.82	0.88	0.94	8	0.19	0.20	0.45	122	3.08	3.32	1.82
6.500	145	2.67	2.89	1.70	40	0.94	1.02	1.01	124	2.90	3.14	1 77	80	2.02	2.19	1.48
6.333	163	3.01	3.27	1.81	33	0.78	0.85	0.92	182	4.26	4.63	2.15	124	3.13	3.40	1.84
6.167	224	4.13	4.51	2.12	10	0.24	0.26	0.51	235	5.50	6.01	2.45	128	3.23	3.53	1.88
6.000	130	2.40	2.63	1.62	19	0.45	0.49	0.70	168	3.93	4.31	2.07	75	0.90	0.99	0.99
5.875	144	2.65	2.92	1.71	38	0.89	0.98	0.99	150	3.51	3.86	1.96	82	2.07	2.28	1.51
5.750	83	1.53	1.69	1.30	54	1.27	1.40	1.18	252	5.90	6.52	2.55	133	3.36	3.72	1.93
5.625	37	0.68	0.76	0.87	55	1.30	1.44	1.20	258	6.04	6.71	2.59	98	2.48	2.76	1.66
5.500	46	0.85	0.95	0.97	46	1.08	1.21	1.10	185	4.33	4.83	2.20	48	1.21	1.35	1.16
5.375	45	0.83	0.93	0.96	23	0.54	0.61	0.78	233	5.45	6.11	2.47	44	1.11	1.19	1.09
5.250	76	1.40	1.58	1.26	48	1.13	1.27	1.13	189	4.42	4.97	2.23	67	1.67	1.88	1.37
5.125	31	0.57	0.65	0.81	49	1.15	1.30	1.14	137	3.21	3.64	1.91	59	1.49	1.69	1.30
5.000	16	0.29	0.33	0.57	94	2.21	2.52	1.59	29	0.68	0.78	0.88	14	0.35	0.40	0.63
4.917	96	1.77	2.03	1.42	113	2.66	3.05	1.75	16	0.37	0.42	0.65	35	0.88	1.01	1.00
4.833	158	2.91	3.36	1.83	135	3.18	3.67	1.92	22	0.51	0.59	0.77	23	0.58	0.67	0.82
4.750	187	3.45	4.00	2.00	109	2.57	2.98	1.73	31	0.73	0.85	0.92	17	0.43	0.50	0.71
4.666	81	1.49	1.74	1.32	82	1.93	2.25	1.50	15	0.35	0.41	0.64	5	0.13	0.15	0.39
4.583	5	0.09	0.11	0.33	119	2.80	3.28	1.81	31	0.73	0.86	0.93	39	0.99	1.16	1.08
4.500	24	0.44	0.52	0.72	225	5.30	6.24	2.50	26	0.61	0.72	0.85	76	1.92	2.26	1.50
4.416	24	0.44	0.52	0.72	156	3.67	4.35	2.09	93	2.18	2.59	1.61	87	2.20	2.61	1.61
4.333	48	0.88	1.05	1.02	49	1.15	1.37	1.17	199	4.66	5.57	2.36	47	1.19	1.42	1.19
4.250	242	4.46	5.37	2.32	41	0.96	1.15	1.07	231	5.40	6.50	2.55	128	3.23	3.89	0.94
4.167	401	7.39	8.96	2.99	81	1.91	2.32	1.52	120	2.81	3.41	1.85	260	6.57	7.97	2.82
4.083	294	5.42	6.63	2.57	88	2.07	2.53	1.59	2	0.05	0.06	0.24	298	7.53	9.21	3.04
4.000	92	1.70	2.10	1.45	18	0.42	0.52	0.72	84	1.97	2.43	1.56	126	3.17	3.91	1.98
3.938	184	3.39	4.21	2.05	35	0.82	1.02	1.01	43	1.01	1.25	1.12	41	1.04	1.29	1.14
3.875	222	4.09	5.12	2.26	94	2.21	2.77	1.66	37	0.87	1.09	1.04	20	0.51	0.64	0.80
3.813	173	3.19	4.03	2.01	27	0.64	0.81	0.90	11	0.26	0.33	0.57	55	1.39	1.75	1.32
3.750	46	0.85	1.08	1.04	3	0.07	0.09	0.30	30	0.70	0.89	0.94	121	3.06	3.89	1.97
3.688	50	0.92	1.18	1.09	46	1.08	1.38	1.18	25	0.58	0.74	0.86	205	5.09	6.51	2.55
3.625	36	0.66	0.85	0.92	104	2.45	3.16	1.78	2	0.05	0.06	0.25	117	2.96	3.82	1.95
3.563	1	0.02	0.03	0.17	145	3.41	4.45	2.11	27	0.63	0.82	0.91	42	1.06	1.38	1.17
3.500	42	0.77	1.01	1.00	184	4.33	5.70	2.39	6	0.14	0.18	0.42	123	3.11	4.10	2.02
3.459	88	1.62	2.15	1.47	187	4.40	5.84	2.42	4	0.09	0.12	0.35	117	2.95	3.91	1.98
4.416	52	0.96	1.28	1.13	209	4.92	6.57	2.56	80	1.87	2.50	1.58	154	3.89	5.20	2.28
3.375	114	2.10	2.83	1.68	154	3.63	4.88	2.21	191	4.47	6.01	2.45	125	3.16	4.25	2.06
3.333	35	0.65	0.88	0.94	103	2.43	3.30	1.82	188	4.40	5.97	2.44	54	1.37	1.86	1.36
3.292	57	1.05	1.43	1.20	86	2.03	2.77	1.66	88	2.06	2.81	1.68	13	0.33	4.50	2.12
3.250	81	1.49	2.05	1.43	95	2.24	3.09	1.76	5	0.12	0.17	0.41	18	0.45	0.62	0.79
3.208	143	2.64	3.67	1.92	97	2.28	3.17	1.78	76	1.78	2.48	1.57	25	0.63	0.88	0.94
3.167	149	2.75	3.86	1.96	85	2.00	2.81	1.68	225	5.27	7.40	2.72	52	1.31	1.84	1.36
3.125	76	1.40	1.98	1.40	35	0.82	1.16	1.08	249	5.83	8.26	2.87	25	0.63	0.89	0.94
3.083	3	0.06	0.09	0.30	39	0.92	1.32	1.15	195	4.56	6.52	2.55	21	0.53	0.76	0.87
3.042	61	1.12	1.62	1.27	127	2.99	4.32	2.08	129	3.02	4.37	2.09	2	0.05	0.07	0.26
3.000	107	1.82	2.66	1.63	99	2.33	3.41	1.85	100	2.34	3.42	1.85	0	0.00	0.00	0.00
2.969	252	4.65	6.86	2.62	68	1.60	2.36	1.54	72	1.68	2.48	1.57	13	0.33	0.49	0.70
2.938	298	5.50	8.18	2.86	102	2.40	3.57	1.89	83	1.94	2.89	1.70	65	1.64	2.44	1.56
2.906	203	3.74	5.61	2.37	166	3.91	5.88	2.43	116	2.71	4.07	2.02	88	2.22	3.34	1.83
2.875	88	1.62	2.45	1.57	179	4.21	6.38	2.53	123	2.88	4.37	2.09	131	3.31	5.01	2.24
2.843	16	0.29	0.44	0.66	115	2.71	4.14	2.14	140	3.28	5.01	2.24	76	1.92	2.93	1.71
2.813	13	0.24	0.37	0.61	25	0.59	0.91	0.95	135	3.16	4.88	2.21	74	1.87	2.89	1.70

Mean P	British Isles 1850-1922 Unadjusted 78.33 I	H	H′	A	The Punjab Unadjusted 354.1 I	H	H′	A	The Punjab Adjusted 354.6 I	H	H′	A
9.000	49	0.63	0.65	0.81	988	2.79	2.89	1.70	582	1.64	1.70	1.30
8.666	93	1.19	1.24	1.11	1,096	3.09	3.22	1.79	517	1.46	1.52	1.23
8.333	93	1.19	1.25	1.12	920	2.60	2.72	1.65	1,096	3.09	3.23	1.81
8.000	128	1.64	1.73	1.31	379	1.07	1.13	1.06	665	1.88	1.98	1.41
7.750	104	1.33	1.41	1.19	1,046	2.95	3.12	1.77	855	2.41	2.55	1.60
7.500	179	2.29	2.43	1.56	1,592	4.49	4.77	2.18	1,164	3.28	3.48	1.87
7.250	292	3.73	3.97	1.99	1,552	4.38	4.67	2.16	1,707	4.81	5.13	2.27
7.000	153	1.95	2.09	1.45	769	2.17	2.32	1.52	1,656	4.67	5.00	2.24
6.833	40	0.51	0.55	0.74	136	0.38	0.41	0.64	1,237	3.49	3.75	1.94
6.666	50	0.64	0.69	0.83	18	0.05	0.05	0.22	292	0.82	0.88	0.94
6.500	209	2.67	2.89	1.70	4	0.01	0.01	0.10	139	0.39	0.42	0.65
6.333	251	3.21	3.49	1.87	80	0.23	0.25	0.50	24	0.07	0.08	0.28
6.167	220	2.81	3.07	1.75	156	0.44	0.48	0.69	47	0.13	0.14	0.37
6.000	78	1.00	1.10	1.05	334	0.94	1.03	1.01	310	0.87	0.95	0.97
5.875	40	0.51	0.56	0.75	377	1.06	1.17	1.08	408	1.15	1.27	1.13
5.750	32	0.41	0.45	0.67	293	0.83	0.92	0.96	449	1.27	1.40	1.18
5.625	34	0.43	0.48	0.69	63	0.18	0.20	0.45	312	0.88	0.98	0.99
5.500	36	0.46	0.51	0.71	14	0.04	0.04	0.20	19	0.05	0.06	0.24
5.375	103	1.32	1.48	1.22	8	0.02	0.02	0.14	19	0.05	0.06	0.24
5.250	248	3.17	3.57	1.89	27	0.08	0.09	0.30	160	0.45	0.51	1.71
5.125	405	5.18	5.88	2.42	208	0.59	0.67	0.82	176	0.50	0.57	0.76
5.000	358	4.48	5.11	2.26	448	1.27	1.45	1.20	0	0.00	0.00	0.00
4.917	280	3.58	4.10	2.02	489	1.38	1.58	1.26	47	0.13	0.15	0.39
4.833	274	3.50	4.04	2.01	338	0.95	1.10	1.05	273	0.77	0.89	0.94
4.750	275	3.51	4.06	2.01	155	0.44	0.51	0.71	512	1.44	1.67	1.29
4.666	230	2.94	3.43	1.85	247	0.70	0.82	0.91	400	1.13	1.32	1.15
4.583	188	2.40	2.81	1.68	499	1.41	1.65	1.28	333	0.94	1.10	1.05
4.500	45	0.58	0.68	0.82	782	2 21	2 60	1.61	238	0.67	0.79	0.89
4.416	101	1.29	1.53	1.24	493	1.39	1.65	1.28	105	0.30	0.36	0.60
4.333	312	3.99	4.76	2.18	181	0.51	0.61	0.78	57	0.16	0.19	0.44
4.250	493	6.30	7.59	2.75	53	0.15	0.18	0.42	102	0.29	0.35	0.59
4.167	259	3.31	4.01	2.00	392	1.11	1.35	1.16	222	0.63	0.76	0.87
4.083	37	0.47	0.57	0.76	765	2.16	2.64	1.62	191	0.54	0.66	0.81
4.000	205	2.62	3.23	1.80	1,077	3.04	3.75	1.94	98	0.28	0.35	0.59
3.938	325	4.15	5.16	2.27	1,209	3.41	4.23	2.06	8	0.02	0.02	0.14
3.875	291	3.72	4.66	2.16	1,164	3.29	4.12	2.03	328	0.93	1.16	0.08
3.813	48	0.61	0.77	0.88	852	2.41	3.04	1.74	996	2.81	3.55	1.88
3.750	53	0.68	0.86	0.93	442	1.25	1.59	1.26	1,795	5.07	6.44	2.54
3.688	113	1.44	1.84	1.36	106	0.30	0.38	0.62	1,682	4.74	6.07	2.46
3.625	85	1.09	1.41	1.19	20	0.06	0.08	0.28	1,056	2.97	3.83	1.96
3.563	24	0.31	0.40	0.63	57	0.16	0.21	0.46	166	0.47	0.61	0.78
3.500	42	0.54	0.71	0.84	408	1.15	1.51	1.23	80	0.23	0.30	0.55
3.459	106	1.36	1.80	1.34	780	2.20	2.92	1.71	231	0.65	0.86	0.93
4.416	310	3.96	5.29	2.30	956	2.70	3.61	1.90	368	1.04	1.39	1.18
3.375	488	6.24	8.40	2.90	937	2.65	3.56	1.89	228	0.64	0.86	0.93
3.333	297	3.80	5.15	2.27	561	1.58	2.14	1.46	291	0.82	1.11	1.05
3.292	133	1.70	2.32	1.52	295	0.83	1.13	1.06	518	1.46	2.00	1.41
3.250	82	1.05	1.45	1.20	530	1.50	2.07	1.44	899	2.53	3.49	1.87
3.208	277	3.54	4.92	2.22	1105	3.12	4.34	2.08	1058	2.98	4.15	2.04
3.167	533	6.81	9.57	3.09	1274	3.60	5.06	2.25	1123	3.17	4.45	2.11
3.125	471	6.02	8.52	2.92	851	2.40	3.40	1.84	1076	3.03	4.30	2.07
3.083	273	3.49	5.00	2.24	347	0.98	1.40	1.18	1094	3.09	4.42	2.10
3.042	160	2.04	2.95	1.72	587	1.66	2.40	1.55	1189	3.35	4.84	2.20
3.000	151	1.93	2.82	1.68	1020	2.88	4.21	2.05	566	1.60	2.34	1.53
2.969	187	2.39	3.53	1.88	930	2.62	3.87	1.97	192	0.54	0.80	0.89
2.938	305	3.90	5.80	2.41	355	1.00	1.49	1.22	35	0.10	0.15	0.39
2.906	310	3.96	5.95	2.44	3	0.01	0.02	0.14	52	0.15	2.22	0.47
2.875	543	6.94	10.50	3.24	247	0.70	1.06	1.03	165	0.47	0.71	0.84
2.843	545	6.97	10.63	3.26	984	2.78	4.25	2.06	248	0.70	1.07	1.03
2.813	388	4.93	7.61	2.76	1509	4.26	6.57	2.56	328	0.92	1.42	1.19

Mean P	Eastern United States Unadjusted 28.41 I	H	H′	A	Eastern United States Adjusted 29.78 I	H	H′	A
9.000	48	1.69	1.75	1.32	13	0.44	0.46	0.68
8.666	43	1.51	1.57	1.25	66	2.22	2.31	1.57
8.333	0	0.00	0.00	0.00	51	1.71	1.79	1.34
8.000	71	2.50	2.63	1.62	6	0.20	0.21	0.46
7.750	152	5.35	5.65	2.38	44	1.48	1.56	1.25
7.500	163	5.73	6.09	2.47	157	5.27	5.60	2.37
7.250	140	4.92	5.24	2.29	231	7.78	8.29	2.88
7.000	36	1.27	1.36	1.17	161	5.40	5.78	2.40
6.833	15	0.53	0.57	0.75	127	4.26	4.58	2.14
6.666	4	0.14	0.15	0.39	102	3.42	3.69	1.92
6.500	2	0.07	0.08	0.28	49	1.65	1.79	1.34
6.333	17	0.60	0.65	0.81	21	0.71	0.77	0.88
6.167	18	0.63	0.69	0.83	19	0.64	0.70	0.84
6.000	9	0.32	0.35	0.59	19	0.64	0.70	0.84
5.875	3	0.11	0.12	0.35	2	0.07	0.08	0.28
5.750	12	0.42	0.46	0.68	4	0.13	0.14	0.37
5.625	13	0.46	0.51	0.71	36	1.21	1.34	1.16
5.500	3	0.11	0.12	0.35	48	1.61	1.80	1.34
5.375	15	0.53	0.59	0.77	24	0.81	0.91	0.95
5.250	65	2.29	2.58	1.61	7	0.24	0.27	0.52
5.125	55	1.94	2.20	1.48	33	1.11	1.26	1.12
5.000	66	2.32	2.65	1.63	46	1.55	1.77	1.33
4.917	120	4.22	4.84	2.20	28	0.94	1.08	1.04
4.833	147	5.17	5.96	2.44	13	0.44	0.51	0.71
4.750	160	5.63	6.52	2.55	26	0.87	1.01	1.00
4.666	88	3.10	3.61	1.90	62	2.08	2.42	1.56
4.583	30	1.06	1.24	1.11	101	3.39	3.97	1.99
4.500	52	1.83	2.16	1.47	54	1.81	2.13	1.46
4.416	122	4.29	5.09	2.26	41	1.38	1.64	1.28
4.333	125	4.40	5.26	2.29	81	1.72	2.05	1.43
4.250	73	2.57	3.09	1.76	82	1.75	2.11	1.45
4.167	29	1.02	1.24	1.11	54	1.81	2.20	1.48
4.083	26	0.91	1.11	1.05	15	0.50	0.61	0.78
4.000	13	0.46	0.57	0.75	70	2.35	2.90	1.70
3.938	22	0.77	0.96	0.98	97	3.26	4.05	2.01
3.875	68	2.39	2.99	1.73	82	2.75	3.44	1.86
3.813	64	2.25	2 84	1.69	39	1.31	1.65	1.28
3.750	27	0.95	1.21	1.10	37	1.24	1.58	1.26
3.688	4	0.14	0.18	0.42	49	1.65	2.11	1.46
3.625	42	1.48	1.91	1.38	36	1.21	1.56	1.25
3.563	88	3.10	4.05	2.01	19	0.64	0.84	0.92
3.500	30	1.06	1.40	1.18	68	2.28	3.00	1.73
3.459	2	0.07	0.09	0.30	90	3.05	4.05	2.01
4.416	20	0.70	0.93	0.96	52	1.75	2.34	1.53
3.375	48	1.69	2.27	1.51	10	0.34	0.46	0.68
3.333	51	1.79	2.43	1.56	5	0.17	0.23	0.48
3.292	10	0.35	0.48	0.69	37	1.24	1.69	1.30
3.250	3	0.11	0.15	0.39	60	2.02	2.79	1.67
3.208	32	1.13	1.57	1.25	49	1.65	2.30	1.52
3.167	128	4.50	6.32	2.51	24	0.81	1.14	1.07
3.125	54	1.90	2.69	1.64	5	0.17	0.24	0.49
3.083	21	0.74	1.06	1.03	3	1.01	1.45	1.20
3.042	2	0.07	0.10	0.32	20	0.67	0.97	0.98
3.000	7	0.25	0.37	0.61	33	1.11	1.62	1.27
2.969	9	0.32	0.47	0.69	40	1.34	1.98	1.40
2.938	5	0.18	0.27	0.52	23	0.77	1.14	1.07
2.906	1	0.04	0.06	0.24	11	0.37	0.56	0.75
2.875	1	0.04	0.06	0.24	1	0.03	0.05	0.24
2.843	3	0.11	0.17	0.41	8	0.27	0.41	0.62
2.813	15	0.53	0.82	0.91	18	0.60	0.93	0.96

TABLE 5.—*Rainfall periodogram, 2⅙ to 9 years*—(Continued)

Mean	I	Pacific coast 1850-1922								Northern Europe 1777-1849							
		Unadjusted 249.7				Adjusted 240.0				Unadjusted 54.24				Adjusted 42.47			
P	F	I	H	H'	A	I	H	H'	A	I	H	H'	A	I	H	H'	A
2.781	1.560	88	0.35	0.55	0.74	276	1.15	1.79	1.34	84	1.55	2.42	1.56	27	0.64	1.00	1.00
2.750	1.577	29	0.12	0.19	0.09	304	1.27	2.00	1.41	175	3.23	5.10	2.26	87	2.05	3.23	1.80
2.719	1.594	11	0.04	0.06	0.24	443	1.85	2.95	1.72	232	4.28	6.83	2.61	171	4.03	6.43	2.54
2.688	1.612	19	0.08	0.13	0.36	437	1.82	2.93	1.71	198	3.65	5.89	2.43	254	5.98	9.65	3.11
2.656	1.631	9	0.04	0.07	0.26	704	2.93	4.78	2.19	47	0.87	1.42	1.19	252	5.93	9.67	3.11
2.625	1.652	70	0.28	0.46	0.68	511	2.13	3.52	1.88	21	0.39	0.64	0.80	259	6.10	10.06	3.17
2.594	1.674	308	1.23	2.06	1.44	431	1.80	3.01	1.74	188	3.46	5.80	2.41	304	7.16	11.99	3.46
2.563	1.697	616	2.47	4.18	2.04	234	0.98	1.66	1.29	217	4.00	6.78	2.60	285	6.71	11.39	3.37
2.531	1.721	1183	4.74	8.15	2.86	67	0.28	0.48	0.69	80	1.47	2.53	1.59	168	3.96	6.81	2.61
2.500	1.746	1820	7.29	12.72	3.57	8	0.03	0.05	0.22	257	4.74	6.53	2.56	49	1.15	2.01	1.42
2.479	1.763	2241	8.98	15.83	3.98	27	0.11	0.19	0.44	564	10.40	18.33	4.28	21	0.49	0.86	0.93
2.459	1.781	2234	8.95	15.96	4.00	70	0.29	0.52	0.72	919	16.95	30.10	5.49	28	0.66	1.18	1.09
2.438	1.800	1526	6.11	11.00	3.32	66	0.27	0.49	0.70	914	16.85	30.30	5.53	79	1.86	3.34	1.83
2.416	1.820	518	2.08	3.79	1.95	362	1.51	2.75	1.66	495	9.13	16.61	4.08	173	4.07	7.40	2.72
2.400	1.836	545	2.18	4.00	2.00	583	2.43	4.46	2.11	212	3.91	7.17	2.68	239	5.63	10.31	3.21
2.375	1.861	895	3.59	6.68	2.58	1761	7.34	13.67	3.70	133	2.45	4.57	2.14	356	8.38	15.60	3.95
2.353	1.883	1045	4.19	7.90	2.81	1654	6.89	12.99	3.60	341	6.29	11.84	3.44	245	5.77	10.86	3.30
2.333	1.907	643	2.58	4.92	2.22	952	3.97	7.57	2.75	206	3.80	7.25	2.69	123	2.90	5.52	2.35
2.313	1.931	51	0.21	0.41	0.64	460	1.92	3.71	1.93	107	1.97	3.80	1.95	37	0.87	1.68	1.30
2.292	1.956	140	0.56	1.09	1.04	444	1.85	3.61	1.90	19	0.35	0.68	0.82	39	0.92	1.80	1.34
2.273	1.981	737	2.95	5.85	2.42	732	3.05	6.04	2.46	19	0.35	0.69	0.83	60	1.41	2.79	1.67
2.250	2.009	1339	5.36	10.78	3.28	1224	5.10	10.25	3.20	18	0.33	0.66	0.81	59	1.39	2.79	1.67
2.222	2.048	1141	4.57	9.36	3.06	1074	4.46	9.14	3.02	2	0.04	0.08	0.28	27	0.64	1.31	1.15
2.208	2.069	790	3.16	6.54	2.56	1195	4.98	10.30	3.21	86	1.59	3.29	1.81	57	1.34	2.77	1.66
2.188	2.101	225	0.90	1.89	1.38	888	3.70	7.77	2.79	172	3.17	6.66	2.58	59	1.39	2.92	1.71
2.167	2.134	427	1.71	3.67	1.92	143	0.60	1.28	1.13	99	1.83	3.91	1.97	20	0.47	1.00	1.00

Mean	I	Northern Europe 1850-1922								British Isles 1850-1922			
		Unadjusted 42.72				Adjusted 39.56				Unadjusted 78.33			
P	F	I	H	H'	A	I	H	H'	A	I	H	H'	A
2.781	1.560	90	2.11	3.29	1.81	7	0.18	0.28	0.53	187	2.39	3.73	1.93
2.750	1.577	39	0.91	1.43	1.19	20	0.51	0.80	0.90	28	0.36	0.57	0.76
2.719	1.594	31	0.73	1.16	1.08	2	0.05	0.08	0.28	25	0.32	0.51	0.71
2.688	1.612	21	0.49	0.79	0.89	6	0.15	0.24	0.49	35	0.45	0.78	0.88
2.656	1.631	18	0.42	0.69	0.83	8	0.20	0.33	0.57	1	0.01	0.02	0.14
2.625	1.652	14	0.33	0.55	0.74	11	0.28	0.46	0.68	8	0.10	0.17	0.41
2.594	1.674	12	0.28	0.47	0.69	56	1.42	2.38	1.54	37	0.47	0.79	0.89
2.563	1.697	51	1.19	2.02	1.42	109	2.75	4.67	2.16	28	0.36	0.61	0.78
2.531	1.721	90	2.11	3.63	1.90	75	1.90	3.27	1.81	85	1.09	1.88	1.37
2.500	1.746	33	0.77	1.34	1.16	36	0.91	1.59	1.26	47	0.60	1.05	1.02
2.479	1.763	12	0.28	0.49	0.70	17	0.43	0.76	0.87	2	0.03	0.05	0.22
2.459	1.781	1	0.02	0.04	0.20	21	0.53	0.94	0.97	71	0.91	1.62	1.27
2.438	1.800	30	0.70	1.26	1.12	28	0.71	1.28	1.13	257	3.28	5.90	2.43
2.416	1.820	65	1.52	2.77	1.66	23	0.58	1.05	1.02	355	4.54	8.27	2.87
2.400	1.836	47	1.10	2.02	1.42	36	0.91	1.67	1.29	326	4.16	7.64	2.76
2.375	1.861	49	1.15	2.11	1.45	22	0.56	1.03	1.01	154	1.97	3.67	1.92
2.353	1.883	44	1.03	1.94	1.39	10	0.25	0.47	0.69	52	0.66	1.24	1.11
2.333	1.907	40	0.94	1.79	1.34	6	0.15	0.29	0.54	16	0.20	0.38	0.62
2.313	1.931	41	0.96	1.85	1.36	45	1.14	2.20	1.48	11	0.14	0.27	0.52
2.292	1.956	19	0.44	0.86	0.93	6	0.15	0.29	0.54	30	0.38	0.74	0.86
2.273	1.981	6	0.14	0.28	0.53	0	0.00	0.00	0.00	65	0.83	1.64	1.28
2.250	2.009	14	0.33	0.66	0.81	66	1.67	3.34	1.83	51	0.65	1.31	1.14
2.222	2.048	65	1.52	3.11	1.76	180	4.55	9.32	3.05	77	0.98	2.01	1.41
2.208	2.069	69	1.62	3.35	1.83	121	3.06	6.33	2.51	126	1.61	3.33	1.82
2.188	2.101	29	0.68	1.43	1.19	99	2.50	5.25	2.29	155	1.98	4.17	2.04
2.167	2.134	54	1.26	2.69	1.64	133	3.36	7.17	2.67	159	2.03	4.33	2.08

Mean	I	The Punjab								Eastern United States							
		Unadjusted 354.1				Adjusted 354.6				Unadjusted 28.1				Adjusted 29.78			
P	F	I	H	H'	A	I	H	H'	A	I	H	H'	A	I	H	H'	A
2.781	1.560	1696	4.79	7.47	2.73	534	1.51	2.35	1.53	41	1.44	2.25	1.50	16	0.54	0.84	0.92
2.750	1.577	1554	4.39	6.92	2.63	624	1.76	2.78	1.67	75	2.64	4.17	2.04	2	0.07	0.11	0.36
2.719	1.594	1426	4.02	6.41	2.53	611	1.72	2.74	1.66	78	2.74	4.37	2.09	7	0.24	0.38	0.62
2.688	1.612	1113	3.14	5.07	2.25	460	1.30	2.10	1.45	29	1.02	1.64	1.28	26	0.87	1.40	1.13
2.656	1.631	685	1.93	3.15	1.77	915	2.58	4.21	2.05	10	0.35	0.57	0.75	34	1.14	1.86	1.38
2.625	1.652	425	1.20	1.98	1.41	1601	4.52	7.47	2.73	60	2.11	3.49	1.87	20	0.67	1.11	1.05
2.594	1.674	358	1.01	1.69	1.30	1905	5.38	9.01	3.00	97	3.41	5.71	2.39	14	0.47	0.79	0.89
2.563	1.697	359	1.01	1.71	1.31	1112	3.13	5.30	2.30	78	2.74	4.65	2.16	18	0.60	1.02	1.01
2.531	1.721	142	0.40	0.69	0.83	217	0.61	1.05	1.02	62	2.18	3.75	1.94	16	0.54	0.93	0.96
2.500	1.746	89	0.25	0.44	0.66	304	0.86	1.50	1.22	61	2.15	3.75	1.94	7	0.24	0.42	0.65
2.479	1.763	361	1.02	1.80	1.34	678	1.91	3.37	1.86	35	1.23	2.17	1.47	12	0.40	0.71	0.84
2.459	1.781	568	1.60	2.85	1.69	847	2.39	4.26	2.06	39	1.37	2.44	1.56	9	0.30	0.53	0.73
2.438	1.800	611	1.72	3.09	1.76	555	1.57	2.83	1.68	31	1.09	1.96	1.39	7	0.24	0.43	0.66
2.416	1.820	341	0.95	1.73	1.31	205	0.58	1.05	1.02	26	0.91	1.66	1.29	10	0.34	0.62	0.79
2.400	1.836	102	0.29	0.53	0.73	85	0.24	0.44	0.66	23	0.81	1.49	1.22	34	1.14	2.09	1.45
2.375	1.861	161	0.45	0.83	0.91	140	0.39	0.73	0.85	7	0.25	0.47	0.69	37	1.24	2.31	1.52
2.353	1.883	540	1.52	2.86	1.69	233	0.66	1.24	1.13	1	0.04	0.08	0.28	38	1.28	2.41	1.55
2.333	1.907	685	1.93	3.68	1.92	97	0.27	0.51	0.71	3	0.11	0.21	0.46	28	0.94	1.79	1.34
2.313	1.931	435	1.23	2.37	1.54	310	0.87	1.68	1.30	2	0.07	0.14	0.37	20	0.67	1.29	1.14
2.292	1.956	92	0.26	0.51	0.71	937	2.64	5.16	2.27	0	0.00	0.00	0.00	20	0.67	1.31	1.15
2.273	1.981	46	0.13	0.26	0.51	1739	4.90	9.70	3.11	5	0.18	0.36	0.60	32	1.07	2.12	1.46
2.250	2.009	230	0.65	1.30	1.14	1899	5.35	10.73	3.27	9	0.32	0.64	0.80	39	1.31	2.63	1.62
2.222	2.048	140	0.40	0.82	0.91	846	2.38	4.87	2.21	6	0.21	0.43	0.66	29	0.97	1.99	1.41
2.208	2.069	69	0.19	0.39	0.62	374	1.05	2.17	1.47	0	0.00	0.00	0.00	24	0.81	1.68	1.30
2.188	2.101	237	0.67	1.41	1.19	147	0.41	0.86	0.93	32	1.13	2.37	1.54	26	0.87	1.83	1.35
2.167	2.134	491	1.39	2.97	1.72	327	0.92	1.96	1.40	33	1.16	2.48	1.58	44	1.48	3.16	1.78

THE CRITERIA OF REALITY IN THE PERIODOGRAM

By DINSMORE ALTER

[University of Kansas, Lawrence, Kans.]

In a recent paper in the Quarterly Journal of the Royal Meteorological Society (*1*), Sir Gilbert T. Walker has developed equations for criteria of reality of periodicities, and has discussed the periodogram and other methods of examining data for them. In this article he refers to an older paper of his, published in the Indian Meteorological Memoirs, (*2*). I had seen neither of these papers when I wrote a discussion of the method in connection with an application to rainfall data of the world (*3*).

Some of the points I have discussed have been treated by Walker in these papers and in a more elegant fashion than mine. His papers are perhaps the most valuable contributions to the theory since Schuster published his original developments (*4*).

However, although Walker's mathematics is entirely correct, he makes an apparent error of application of the equation he has derived. Before discussing this it may not be out of place to review his development of a criterion for reality of a periodogram peak, since the Indian Meteorological Memoirs are not available to a rather large number of meteorologists. The exact form of development and the notation here are different from his, although the results are the same.

Suppose that a periodogram has been computed. If I_m is the mean intensity and I the intensity of any peak:

$$\text{Define } H \equiv \frac{I}{I_m}$$

Schuster shows that the probability, or more properly named the expectancy ratio, of any one specified peak being of height h, assuming merely accidental variations of the data, is e^{-h}. As Walker points out, it is obvious that in our periodogram, with its many peaks from which to choose, we are much more likely to find one of this height.

Since the expectancy of any point being this high or higher is e^{-h}, the expectancy of it being less than this high is $(1-e^{-h})$. The expectancy that none of m *independent* points is this high is

$$(1-e^{-h})^m = 1 - me^{-h} + \frac{m(m-1)e^{-h}}{2} - + \ . \ . \ .$$

Therefore the expectancy that at least one will be this high is

$$me^{-h} - \frac{m(m-1)e^{-h}}{2} + \frac{m(m-1)(m-2)e^{-3h}}{6} + \ . \ . \ . \ . \ . \ .$$

Except for notation, this equation is identical with Walker's equation, which is developed in terms of an expectancy of one-half.

From here we will continue independently. Given, m *independent* points, we can choose any expectancy ratio *which satisfies our judgment of what is necessary to make physical reality of periods probable*. We can then solve for h and if we find a peak of height h, we will assume it probably real. The expectancy ratio to be chosen as a criterion is a matter of judgment. One man will demand a higher ratio to satisfy him than will another. There can be no mathematical criterion which will set a definite value above which all will agree to the reality of the period. It will also vary with the physical probability of a period. For example, if we were working with rainfall data and knew of no periodicities in it nor in any other closely related meteorological data nor of any reason why we would expect a period, we would demand a higher ratio than if, perchance, a period had been established in temperature. Also, if a peak indicates a period of length simply related to some other plausibly connected phenomenon, we will not demand as high a ratio as otherwise.

Several high independent peaks are less likely to occur by accident than is one.

Let p_1 be the expectancy ratio or any peak of height h_1. Suppose we have z such peaks. The probability of their simultaneous occurrence is:

$1-(1-p_1)(1-p_2) \ . \ . \ . \ . \ (1-p_z)$. This equation assumes $z \leqq m$.

Walker states in paragraph six of the later paper: "If we have determined the values of, let us say, 20 amplitudes C_k in the periodogram and have picked out the largest term, we must, if we wish to estimate the liklihood that the period is real, compare its amplitude, not with the probable value of a single random amplitudes but with the largest of 20 amplitudes produced by chance, and this will be 2.21 times as great."

The theory has been developed on the basis of m *independent* points in a periodogram. The number of *computed* points is much larger than this. Let us illustrate by the rainfall paper cited above (*3*). A periodogram has been computed from 72 yearly values of data, with periodicities examined between 9 and $1\frac{1}{8}$ years; 84 points have been computed for the periodogram. These are so close together that it is impossible for a peak to have a much greater h than has been computed for it and certainly for no peak entirely to have escaped notice. Yet, pressing the application, the greater the number of such points one might compute, the higher he would expect to find peaks through mere accident.

There are as many entirely *independent* points within the periodogram as there are Fourier harmonics of the stretch of data between the limiting periods chosen for the periodogram. In this case, the eighth to twenty-third are included and we find 26 independent values instead of 84. This number, however, minimizes the independence too much, for if the highest point of the periodogram were to occur half way between two Fourier terms, there would be 90° phase divergence at the beginning and the end of the data between it and adjoining Fourier values. This would be sufficient to cause a material difference in height between the assumed highest peak and these terms. In other words, computing twice as many periodogram points as there are Fourier terms would cause us to expect higher peaks through accident. Thus we see that once again we are left to our judgment as to the criterion to be applied, this time in the number of terms to be considered as *independent*. The number is obviously less than the number of terms which should be computed for the periodogram, and greater than the number of Fourier terms of the stretch of data. Possibly some one may be able to develop a satisfactory criterion for everyone. I would estimate possibly $1\frac{1}{2}$ times the Fourier number as reasonable.

LITERATURE CITED

(1) WALKER, SIR GILBERT T.
1925. ON PERIODICITY. Quart. Jour. Roy. Met'l Soc., 51, no. 216, pp. 337-346.

(2) WALKER, SIR. GILBERT T.
1914. ON THE CRITERION FOR THE REALITY OF RELATIONSHIPS. Calcutta, Indian Meteorological Memoirs, 21, part 1.

(3) ALTER, DINSMORE.
AN EXAMINATION BY MEANS OF SCHUSTER'S PERIODOGRAM OF RAINFALL DATA FROM LONG RECORDS IN TYPICAL SECTIONS OF THE WORLD. Mo. Wea. Rev., 54: 44-56.

(4) SCHUSTER, SIR ARTHUR.
1900. THE PERIODOGRAM OF MAGNETIC DECLINATION AS OBTAINED FROM THE RECORDS OF THE GREENWICH OBSERVATORY DURING THE YEARS 1871-1895. Cambridge Phil. Soc. Trans., 18, p. 107.
1905. THE PERIODOGRAM AND ITS OPTICAL ANALOGY. Royal Soc. Proc., 77, 146-140.
1905. ON SUN-SPOT PERIODICITIES. PRELIMINARY NOTE. ibid., 141-146.
1906. ON THE PERIODICITIES OF SUN SPOTS. Phil. Trans. Roy. Soc., A 206, 69-100.

SOME OUTSTANDING TORNADOES

(Abstract)[1]

By CLARENCE J. ROOT

[Weather Bureau Office, Springfield, Ill.]

There is no reason to believe that in prehistoric days, nor during the early history of our country, tornadic storms were any less numerous or lacked the severity of those of to-day. As has been often pointed out, the greater completeness of the record in later years is simply a result of the increase in population affected by tornadoes. Thus an early list gives four times as many in the seventies as in the preceding 76 years, and contains very little data that would enable one to classify them as to magnitude. Complete statistics seem to be very meager prior to 1875.

With a view to having in compact form a record of the outstanding tornadoes that have occurred in the United States, the writer has compiled a list and brief description[2] of those which fall into any of the groups given below.

A. Storms with a death list of 50 or more,
B. With property loss of $500,000 or more,
C. With path more than 50 miles long,
D. With path 50 to 100 miles long,
E. With paths more than 100 miles long.

TABLE 1.—*Percentage distribution of the 4 groups of important tornadoes*

Group	State having maximum number	Percentage in States	
		West of Mississippi	East of Mississippi
A	Iowa, Texas, 10 per cent each	53	47
B	Kansas, 11 per cent	44	56
C	Iowa, 10 per cent	47	53
D	Missouri, 13 per cent	56	44
E	Alabama, 10 per cent	31	69

The list contains 158 class one or outstanding tornadoes. In summarizing (Table 1) the results of the work, tornadoes that occurred in two States are given a weight of one-half in each and, likewise, when they occurred in three States a weight of one-third is charged to each.

According to the compilation, Iowa leads in important tornadoes with 9 per cent of the total number, the other States following in this order: Missouri, 8; Illinois, 7; Kansas, Tennessee, Alabama, Minnesota, and Wisconsin, each 6; Oklahoma and Indiana, 5 each. From the Plains States eastward, all States are represented except Maine, New Hampshire, Vermont, Rhode Island, Connecticut, New York, Virginia, and West Virginia—54 per cent occurred east of the Mississippi River.

In total number of deaths from these larger tornadoes Illinois leads by a wide margin, there being 631 deaths as a result of a single storm, a number greater than the total of all these class one tornadoes in any other State.

It was supposed that the 293-mile path of the "Mattoon" tornado of May 26, 1917, was the longest of record, but five earlier ones are now found exceeding 300 miles. Two of these had some long gaps, the information is very vague concerning two others, and it is not stated whether the fifth was continuously destructive. In our travels over the Illinois and Indiana portions of the tri-State tornado of March 18, 1925, we found absolutely no skipping in the 130 miles covered. The last-named storm exceeded all others in loss of life and value of property destroyed. The official report gave the number of deaths as 742, and the property loss at $16,500,000. There have been 8 tornadoes with a loss of life exceeding 100, and 2 with more than 135. In 15 storms the property loss has exceeded a million dollars, and in three of them it was ten million dollars or more.

Searching through some 700 records has brought out certain facts that are, perhaps, worthy of mention. A large number of tornadoes occur nearly every year, but many are of an incipient nature or do little damage. In some cases they have a tendency to form in groups, and to move in parallel paths in a northeasterly direction. A remarkable number continue for many miles over a straight path. The great tornado of March 1925, varied scarcely more than a mile or two from a straight line in 178 miles of its course. In a list of 384 tornadoes where the direction is stated, 78 per cent moved northeast, the others in some easterly direction. Of 452 tornadoes, 80 per cent were timed between noon and 6 p. m., and 15 per cent between 6 p. m. and midnight.

Kansas leads in number but the length of path probably averages less than farther east, and the greatest number of persons killed in a single tornado in that State was but 23. Tornadoes often occur when there are opposing northerly and southerly winds, with marked thermal difference.

It is questionable whether the observance of a funnel cloud should be made a requisite in defining a storm as a tornado.[1] In connection with the one in March, 1925, very few thought they saw a funnel cloud and these persons were not very definite. None was observed at St. Louis when that city was visited by a severe tornado on May 27, 1896. All through these old reports the statement recurs that two clouds came together, one from the northwest and one from the southwest. Professor Henry[3] says the character of the pendant funnel-shaped cloud varies with geographic position and the average hygrometric state of the air. It seems to the writer that if there is a long and narrow path, with an easterly movement of progression, it is safe to classify the storm as a tornado, especially if light débris aloft is thrown out to the left of the path.

[1] Paper read at meeting of American Meteorological Society, Kansas City, Dec. 28-29, 1925.

[2] These are on file in the library of the U. S. Weather Bureau, Washington, D. C.

[1] Dr. Humphreys stated that a funnel-shaped cloud was not always an accompaniment of a tornado though there was some confusion in the definition of the term. Mr. Reed mentioned a tornado in Iowa that had three branches, also one that had made a complete circle, with a radius of about 2 miles, in its path.

[3] Henry, Professor A. J., Monthly Weather Review, April, 1925.

List of most important tornadoes with special reference to cities that suffered severe damage or loss of life

Prepared by CLARENCE J. ROOT

[Weather Bureau Office, Springfield, Ill.]

Date	Place	For entire tornado: Killed	Injured	Property loss (estimated)	Authority	Remarks
1804, Apr. 4	Jones County to Columbia County, Ga.				Report of C. S. O., 1875, p. 437	Considered the most destructive in Georgia prior to 1875.
1805, June 5	Missouri, Illinois, and Indiana				Jonesboro, Ill. Gazette, *ca.* June 5, 1925.	Unusually long path.
1852, Apr. 13 or 30	Illinois, Indiana, and Kentucky				Report of C. S. O., 1877, p. 526, and 1872, p. 193.	Known as the "Great Tornado." Said to be the most extensive of record prior to 1875.
1875, Mar. 20	Harris County, Ga., to Horry County, S. C.				Report of C. S. O., 1875, p. 398-399	Unusually long path.
1875, Mar. 20	Muscogee County, Ga., to extreme east South Carolina.				Report of C. S. O., 1875, p. 398-399	Unusually long path.
1875, July 26	Erie, Pa. (near)	134		$500,000	Finley, J. P., 600 Tornadoes (Prof. Paper of the U. S. Signal Service, no. 7, p. 9).	
1877, Mar. 8	Southwest Mississippi to Tallapoosa County, Ala.				Report of C. S. O., 1877, p. 458	Unusually long path.
1879, Apr. 16	Alabama, Georgia, South Carolina			200,000	Mo. Wea. Rev., April, 1879, p. 10	Unusually long path.
1880, Apr. 18	Marshfield, Mo				Mo. Wea. Rev., April, 1880, p. 12	At Marshfield: deaths, 65; injured, 200. Loss in Barry and Webster Counties, $1,000,000.
1881, July 15	New Ulm, Minn	18	98		Mo. Wea. Rev., July, 1881, p. 17-18	Loss at New Ulm, $300,000 to $500,000.
1882, June 17	Grinnell, Ia	100			Mo. Wea. Rev., June, 1882, p. 16	At Grinnell: 60 killed; 150 injured; loss, $600,000.
1883, Aug. 21	Rochester, Minn				Mo. Wea. Rev., Aug., 1883, p. 187	At Rochester: deaths, 31; injured, 100; dwellings destroyed, 135; Olmstead County farm losses, $200,000.
1884, Feb. 19	Alabama, Georgia, and adjacent States (Group of tornadoes.)	182			Report of C. S. O., 1890, p. 700. Also Mo. Wea. Rev., 12: 48. Also Finley, J. P., in U. S. Signal Service Prof. Paper, no. 16, 1885.	Said to be greatest in number and most destructive on one day since organization of Weather Service.
1885, Aug. 23	Camden, N. J	6	100	500,000	Mo. Wea. Rev., 13: 205	
1885, Sept. 8	Washington Court House, Ohio	6	100	500,000	Mo. Wea. Rev., 13: 231	No mention of rural casualties or losses.
1887, Apr. 21	Prescott, Kans	20	237	1,000,000	Mo. Wea. Rev., 17: 108	
1890, Mar. 27	Louisville, Ky	106	250	3,500,000	Mo. Wea. Rev., 18: 74	At Louisville: 76 killed; 200 injured; loss, $2,500,000.
1893, July 3	Pomeroy, Ia	89		213,000	Report, Chief of Wea. Bur., 1893, p. 319.	At Pomeroy: 73 killed; loss, $175,000.
1894, Oct. 2	Little Rock, Ark	4		500,000	Report, Chief of Wea. Bur., 1894, p. 287.	
1896, May 15	Sherman, Tex				Mo. Wea. Rev., 24: 83	At Sherman: killed, 61; injured, 150.
1896, May 27	St. Louis, Mo	306		12,904,000	Mo. Wea. Rev., 24: 77	Most destructive in United States up to this time. At St. Louis: deaths, 137; loss, $10,000,000. At East St. Louis: deaths, 118.
1898, Jan. 12	Ft. Smith, Ark				Mo. Wea. Rev., 26: 18	At Fort Smith: killed, 33; 19 subsequently died; 44 others seriously injured; loss, $450,000.
1899, Apr. 27	Kirksville, Mo	34		250,000	Clim. Data, Missouri Sec., April, 1899.	Path only 4 to 6 miles in length.
1899, June 12	New Richmond, Wis				Clim. Data, Wisconsin Sec., June, 1899.	At New Richmond: deaths, 100; injured, 100.
1900, Nov. 20	Southeastern Arkansas, northern Mississippi, and western Tennessee.	73		500,000	Mo. Wea. Rev., 28: 499	Figures for series of six tornadoes. One with unusually long path.
1902, May 18	Goliad, Tex	114	230	50,000	Clim. Data, Texas Sec., May, 1902	No mention of storm outside of Goliad.
1903, June 1	Gainesville, Ga	98	175	1,000,000	Clim. Data, Georgia Sec., June, 1903	Path but 4 miles in length.
1904, Aug. 20	Minneapolis and St. Paul, Minn	14		1,500,000	Clim. Data, Minnesota Sec., August, 1904.	Property loss at Minneapolis, $500,000.
1905, May 10	Snyder, Okla	96		270,000	Clim. Data, Oklahoma Sec., May, 1905.	At Snyder: deaths, 87; seriously injured, 49; loss, $250,000.
1908, Apr. 24	Rapides Parish, La., to Tillman, Miss.	91	398	182,000	Mo. Wea. Rev., 36: 131	
1908, Apr. 24	Livingston Parish, La. to Wayne County, Miss.	120	190	400,000	Mo. Wea. Rev., 36: 131	
1909, Mar. 8	Brinkley, Ark				Clim. Data, Arkansas Sec., April, 1909	At Brinkley: Deaths, 49; injured, 600; loss, $600,000.
1909, Apr. 29	Southwest corner Tennessee to Scott County, Tenn.				Mo. Wea. Rev., 37: 152	Unusually long path.
1913, Mar. 23	Omaha, Nebr	94	[1]	3,500,000	Mo. Wea. Rev., 41: 306	Data are for Omaha; no mention of outside deaths or losses.
1913, Mar. 23	Terre Haute, Ind	21	250	1,000,000	Mo. Wea. Rev., 41: 359. Also Clim. Data, Indiana Sec., 1913, p. 359.	No mention of rural casualties or losses.
1915, Nov. 10	Great Bend, Kans	11	50 to 75	1,000,000	Clim. Data, Kansas Sec., November, 1915.	Figures for Great Bend and vicinity. Most deaths from a Kansas tornado up to this time.
1917, Mar. 23	New Albany, Ind	45	[1]	1,000,000-1,500,000	Clim. Data, Indiana Sec., March, 1917. Also Rep't, Chief of Wea. Bur. 1917-18, p. 31.	Figures for New Albany. Considerable damage at Harrod's Creek, Ky.
1917, May 26	Illinois and Indiana	103			Clim. Data, esp. Illinois Sec., May, 1917, p. 40: Also Indiana Sec., May, 1917.	One of the longest paths of record. The figures for deaths, number injured, and property loss are as follows: State of Illinois: 101, 638, $2,500,000; Mattoon, Ill., 53, 400, $1,200,000. Charleston, Ill., 38, 182, $781,000, respectively.
1917, May 27	Lake County, Tenn., to Graves County, Ky.	70	370	2,000,000	Clim. Data, Kentucky Sec., May, 1917, p. 36, and Tennessee Sec., May, 1917.	
1918, Aug. 21	Tyler, Minn	36		1,000,000	Report, Chief of Wea. Bur., 1918-19, p. 38.	
1919, Mar. 16	Delhi, La., to Sunflower County, Miss.	35		1,000,000	Report, Chief of Wea. Bur., 1919-20, p. 37.	
1919, June 22	Fergus Falls, Minn	59		3,500,000	Report, Chief of Wea. Bur., 1919-20, p. 37.	
1920, Mar. 28	Chicago-Melrose Park, Ill	20	300	2,000,000	Clim. Data, Illinois Sec., March, 1920	Only second tornado to visit Chicago, the previous one being very small.
1920, Mar. 28	Kane, Cook, and Lake Counties, Ill	8	100	1,000,000	Clim. Data, Illinois Sec., March, 1920	
1920, Mar. 28	Deatsville, Ala., to La Grange, Ga	50		1,400,000	Report, Chief of Wea. Bur., 1920-21, p. 30-31.	
1920, Apr. 20	Mississippi and Alabama	87			Report, Chief of Wea. Bur., 1920-21, p. 30, 34.	Loss in Alabama, $1,000,000.

[1] Several hundred.

List of most important tornadoes with special reference to cities that suffered severe damage or loss of life—Continued

Date	Place	For entire tornado			Authority	Remarks
		Killed	Injured	Property loss (estimated)		
1920, May 2	Peggs, Okla.				Report, Chief of Wea. Bur., 1920-21, p. 37.	At Peggs: Killed, 60.
1921, Apr. 13	Melissa, Tex.	11		$500,000	Report, Chief of Wea. Bur., 1921-22, p. 48.	All at Melissa.
1921, Apr. 15	Texas and Arkansas	61			Report Chief of Wea. Bur., 1921-22, p. 39, 49.	Loss in Arkansas $1,225,000.
1922, Apr. 17	Illinois, Indiana, and Ohio	16		900,000	Report, Chief of Wea. Bur., 1922-23, p. 33. 39.	Unusually long path.
1924, Apr. 30	Lawrenceville, Ga., to Hickory Grove, S. C.	10		2,200,000	Clim. Data, Georgia Sec., April, 1924; also South Carolina Sec., April, 1924.	Anderson, S. C., suffered severely.
1924, June 28	Lake Erie	85		12,000,000	Report, Chief of Wea. Bur., 1924-25; also Mo. Wea. Rev., 52: 309, 396.	At Sandusky: Deaths, 8; injured, nearly 100 loss about $1,000,000. At Lorain: Deaths, 73; injured, 200; loss, $11,000,000.
1924, July 13	Butler County, Kans.	1		2,000,000	Clim. Data, Kansas Sec., July, 1924	Much damage in Augusta.
1925, Mar. 18	Missouri, Illinois, and Indiana	[3] 695	[3] 2,027	16,500,000	Clim. Data, Illinois Sec., Indiana Sec, Missouri Sec. March, 1925. See also, reports of American Red Cross.	Greatest of all tornadoes. Path unusually long. Property loss: Annapolis, Mo., $400,000; Gorham, Ill., $150,000; Murphysboro, Ill., $10,000,000; De Soto, Ill., $300,000; West Frankfort, Ill., $545,000; Griffin, Ind., $225,000; Princeton, Ind., $1,800,000. Missouri, $564,000; Illinois, $13,193,000; Indiana, $2,775,000. Gorham, De Soto, Parrish and Griffin were wiped out. Killed and injured, including all deaths that have occurred since the tornado (final American Red Cross figures): Gorham, Ill., and vicinity, 37 and 170; Murphysboro, Ill., and vicinity, 242 and 638; De Soto, Ill., and vicinity, 68 and 127; West Frankfort, Parrish, Ill., and vicinity, 181 and 455; Hamilton County, Ill. 36 and 98; White County, Ill., 29 and 42; Griffin, Ind., and vicinity, 25 and 202; Princeton, Ind., and vicinity, 45 and 152. Missouri, 13 and 63; Illinois, 606 and 1,563; Indiana, 76 and 401, respectively.

[3] Barron and Root traveled over the tornado track during the period two to ten days after the storm. At that time there was much confusion as to the number of killed and injured. The American Red Cross has prepared an accurate and authenic list of the killed and injured, including those who have died since the storm. Through the courtesy of Mr. Henry M. Baker, National Director of Disaster Relief, these figures are now available.—C. J. R.

NOTES, ABSTRACTS, AND REVIEWS

AVALANCHE AT BINGHAM, UTAH

By J. CECIL ALTER

[Weather Bureau Office, Salt Lake City, Utah, March 5, 1926]

The snowslide which ran out of Sap Gulch into Bingham Canyon, stopping about 3 miles above Bingham town, Salt Lake County, Utah, at 9 a. m., February 17, 1926, demolished 14 miners' cottages and a 3-story frame boarding house, grouped near the mouth of the gulch, killed 36 persons and injured 13 others out of a total of about 65 who were in its path. Numerous other slides occurred about the same time in the mountains adjacent to Provo, Salt Lake City, and Ogden, though little additional damage or inconvenience resulted.

A comparatively heavy snowfall occurred during the afternoon and night of February 16, 1926, over the northern Wasatch Mountains, extending generally from eastern Juab to Cache Counties, inclusive. The depth of new snow averaged about 12 inches over the area mentioned, but averaged about 17 inches over Salt Lake County, ranging from 8 inches at Midvale (elevation 4,365) and 10 inches at Salt Lake City (elevation 4,300), to 27 inches at High Line City Creek (elevation 5,300) and 24 inches at Mountain Dell (elevation 5,500). Twelve or 15 inches fell over Sap Gulch watershed (elevation about 6,000 to 6,500)

The new snow was deposited on a general layer of crusted old snow in the mountains, and became unstable toward the end of the storm. Thus many of the better known snowslides ran, a few casting their avalanches which had not disgorged for a great many years. The Sap Gulch slide is reported to have run only twice in the past 30 years, and then with much smaller discharges. This latest slide seems to have started by the slipping of a large area of new snow, possibly aided by blasting in a surface mine not far distant.

Once started, the moving snow skidding over the glossy old snow, was augmented by contributions within and to the sides of its path, though it was also depleted by a large amount in a depression on the way down. No important hindrance was offered by trees or other objects in any part of its 2-mile path; and it gained a little speed as indicated in its leaping off a 100-foot ledge just above the destroyed buildings, clearing 50 feet of ground at the base of the ledge. However, no testimony was given by observers as to any extraordinary wind or air pressure; and other buildings near the end of the slide were not moved or damaged.

Survivors interviewed agree that there was a brief roaring sound, then a definite jiggling of the buildings as in a sharp earthquake, and then the crash of the avalanche. The buildings in the snow path were crushed like eggshells, most of them being swept along a few rods with the rolling, mixing avalanche. Most of the fatalities were instantaneous, though several persons were rescued alive and expired later. Most of the survivors were dug out of the débris at great effort, many of them after being imprisoned several hours. Some, however, were thrown free of harm, the outstanding escape being made by a man taking a shower bath, who though naked was carried 150 feet on the crest of the slide to safety.

The mass of moving snow, came to a stop a few yards below the group of buildings destroyed, the dead avalanche being about 800 feet long, 100 feet wide, and from 10 to 20 feet deep. All of this snow was carefully moved before it could be certain that it held no more bodies. Fortunately laboring men with proper tools were available in large numbers to effect the rescues as quickly as was humanly possible. Hospital service was also available

nearby for all the needy, in the first-aid rooms of the mining companies. The property loss is estimated at $40,000.

Three slides in Provo Canyon stopped rail and automobile traffic a few days; one slide at Ophir mining camp, Tooele County, ran at 1 a. m., February 17, demolishing two houses, one of them occupied by four persons who escaped; one slide at Alta, Salt Lake County, did little or no harm; and two slides in Mill Creek Canyon, this county, swept away some of the electric power line and robbed the power plants of water for a few hours; slides in Big Cottonwood and City Creek Canyons, this county, also dammed the streams temporarily, requiring the diversion of other waters into the Salt Lake City mains for a few hours; and two slides in Ogden Canyon blocked traffic several hours on the rail and automobile roads. The heavy snowfall in this storm delayed trains somewhat and hindered automobile traffic generally in the district, though all lines were soon open, and in a few days the valleys were bare.

GLACIER WATER UTILIZED IN CITY'S WATER SUPPLY

According to Engineering News-Record of March 4, 1926, the city of Boulder, Colo., has taken steps to purchase from the United States Government the land occupied by the Arapahoe glacier, distant about 15 miles from the city, with the object of supplementing the city's water supply therefrom. This is the first instance so far as known of a town or city in this country deriving a part of its water supply from a glacier.

PROVISIONAL SUN-SPOT RELATIVE NUMBERS, WOLFER, FOR 1925

[Reprinted from tables by A. Wolfer in Meteorologische Zeitschrift for April, July, October, 1925, and January, 1926]

1925	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	0	8	-----	10	19	40	22	23	76	-----	-----	-----
2	0	19	8	8	23	83	28	22	59	62	-----	62
3	7	17	7	7	35	92	39	26	80	55	-----	-----
4	7	7?	-----	14	35	80	47	0	73	54	17	64
5	0	8	0	19	31	94	66	8	60	-----	-----	67
6	0	8	-----	17	43	73	50	23	71	35	-----	-----
7	0	-----	-----	24	37	89	48	28	43	31	-----	60?
8	0	38	0	21	34	118	61	40	38	-----	-----	80
9	0	32	0	31	43	114	-----	56	65	-----	39	56
10	0	40	0	-----	39	109	43	70	47	-----	-----	-----
11	8	39	9	-----	-----	102	38	57	36	-----	-----	88
12	11	53	17	52	-----	89	37	47	30	48	-----	100
13	-----	71	17	57	27	88	39	46	21	62	-----	139
14	0	-----	-----	42	38	56	20	31	30	-----	-----	-----
15	-----	49	-----	35	47	35	21	7	42	87	-----	-----
16	-----	15?	20	31	47	17	41	7	60	96	-----	157
17	-----	31	28	42	78	8	40	7	-----	-----	-----	136
18	-----	12	34	35	83	13	31	10	51	109	-----	132
19	-----	26	32	60	70	7	28	28	60	57?	-----	103?
20	-----	13	24	-----	69	0	35	24	67	-----	-----	137
21	11	11	17	40	74	0?	38	30	76	123	-----	128
22	-----	-----	-----	44	71	18	20	19	83	116	-----	105?
23	8	13	-----	36	54	14	0	31	77	98	124	111
24	8	14	-----	-----	39	7	16	30	-----	-----	-----	-----
25	-----	0	-----	-----	32	12	27	-----	76	76	136	-----
26	-----	7?	-----	-----	28	11	28	64	82	59	-----	-----
27	-----	0?	43	-----	41	16	30	64	86	51	68?	-----
28	0	14	38	7	40	14	33	71	77	44	-----	100
29	0	-----	34	7	28	11	49	77	77	33	-----	-----
30	-----	-----	24	16	26	17	34	-----	-----	29	62	84
31	0	-----	22	-----	17	-----	-----	92	-----	-----	-----	91
Means	3.2	201.8	18.7	28.5	43.0	47.6	34.8	35.8	60.9	66.8	74.3	100.0

EVAPORATION IN VEGETATION AT DIFFERENT HEIGHTS

Mr. Frank C. Gates in the American Journal of Botany for March, 1926, pp. 167–178, presents the results of a study of the rates of evaporation encountered by plants at various heights above ground level under various weather conditions during 40 to 52 days during the season of greatest evaporation in the years 1917–1922 inclusive. Standard Livingston porous cup atmometers were used. The scene of the investigations was the Douglas Lake region of Cheboygan county, Michigan.

Looking over the results as a whole, it is plainly evident that there is always an increase in the rate of evaporation as one increases the height of the instrument above the ground. The wide range of values, however, also clearly shows that the local factors are of great importance in determining the actual magnitude of the increase. Likewise, the region and the time of year need consideration. In the present work the increase in height amounted to from 0.2 meter to 5.8 meters. The atmometers were maintained at the top of the crown in order to evaluate the conditions that the plants were meeting as they grew higher from the ground levels at which they started. The climatic variations in different years . . . account for a wide variation in values for any given spot. Aside from this fact, however, the greatest rates of increase were in the bog sets because the ground rate was there so distinctly low. Next came the marsh series and last the upland tree series . . .

An increase in evaporation was uniformly shown, even if the atmometer at the higher level was only 0.2 meter above the lower.

It appears that, in the crowns of the plants utilized, the increase is rapid at first but decreases with increase in height.

A plant meets conditions of increasing severity as it grows upward . . . In this region and in this series of experiments, this change in conditions has meant, under the conditions of experimentation, an increase of 6.06 c. c./m./day (to 4 meters) in pine groves; 3.55 c.c./m.day (to 6.1 meters) in aspen groves; 13.78 c. c./m./day (to 1.9 meters) in bogs; 10.56 c.c. /m./day (to 1.3 meters) in a bog-swamp; and 7.83 c.c. /m./day (to 1.1 meters) in marshes—all with white atmometers. With black atmometers the increases were 11.1 c. c./m./day (to 4.6 meters) in aspen groves, and 8.99 c. c./m./day (to 1.1 meters) in marshes.

WARMEST FEBRUARY AT LONDON IN 156 YEARS

February temperature was a record in England, and the observations at the Greenwich Observatory published in the Daily Weather Reports of the Meteorological Office and in the Weekly Returns of the Registrar-General show some exceptional results. The mean air temperature for the month at Greenwich was 45.7° F., which is the highest mean for London or Greenwich during the last 156 years; it is 6.9° above the monthly normal for the 150 years from 1770 to 1919, and in practical agreement with the normal for April. In this long series of years the February mean for 1869 was approximately in agreement with that for 1926, and the only other means of 45° or above were 45.3° in 1779 and 45.1° in 1872. There were two days, February 21 and 26, with the shade temperature above 60°, and there were 11 days with the temperature above 55°; there were 8 days with the temperature for the 24 hours 10° or more in excess of the normal, while the only days with the temperature below the normal were February 9 to 14. The minimum or night temperature was above 40° on 17 nights, and there were only two nights, February 13 and 14, with frost in the shade. On two days, February 22 and 26, the black-bulb thermometer in the sun's rays exceeded 100°, the respective readings being 106° and 111°, but the duration of bright sunshine for the month was small, registering only 1.3 hours a day on the average, while the normal is 2.0 hours. Separating the mean of 150 years into periods of 50 years, the means at Greenwich for February at 38.1° for 1770–1819, 39.0° for 1820–1869, 39.4° for 1870–1919; the mean for the 150 years is 38.8°. The normal for 35 years, 1880–1915, in general use by the Meteorological Office is 39.8°.—*Nature, March 13, 1926.*

CLIMATIC CHANGES IN WESTERN AMERICA [1]

It is now more than 10 years since Ellsworth Huntington first employed the growth rings of the big trees of California to demonstrate the existence of variations of rainfall during the past 4,000 years. The chief difficulty has been the conversion of the curve of tree growth into a curve of rainfall. Trees grow more rapidly when they are young than when they are middle-aged, while in old trees the growth becomes irregular, so that the equation connecting tree-growth and rainfall at the present day can not be applied with safety to the early rings of the very oldest trees. Huntington, fresh from an investigation of climatic changes in western Asia, read into the tree-growth curve a close similarity to the fluctuations of level of the Caspian and applied a "Caspian correction factor" to the curve of tree-growth. The early levels of the Caspian are themselves very problematical, however, and the extrapolation to western America did not inspire confidence.

A more trustworthy control has now been supplied by the variations in the level of the salt lakes of the Great Basin in close proximity to the trees. It is well known that during the Pleistocene Ice Age the Great Basin was occupied by a number of lakes, of which the largest have been termed Lakes Bonneville and Lahontan. This was many thousand years ago, but some investigations carried out by J. Claude Jones into the salt content of Lakes Pyramid and Winnemucca, which occupy part of the old basin of Lake Lahontan, show that these lakes have been accumulating salt for a period probably between 2,500 and 3,000 years, so that at some date between 1,000 and 500 B. C. they consisted of fresh water. A lake formerly salt may become fresh either by overflowing or by becoming dry for a period long enough for the salt deposit to be covered by a thick layer of detritus. There is no evidence that the lakes have ever overflowed, so that we must adopt the second alternative and suppose that a long dry period ended between 1,000 and 500 B. C. If J. C. Jones had left the matter there he would have done much to assist the study of climatic changes, but, unfortunately, he has confused the deposits of the old Pleistocene Lake Lahontan with those of the modern lakes and has marred his work by some unwarranted statements as to the survival of the lion, horse, and camel in North America into historic times.

In the same publication E. Antevs has made a thorough revision of Huntington's data of tree growth and has prepared a series of curves corrected for the various sources of error from intrinsic evidence only. His various curves for damp and dry localities agree well among themselves and seem to establish the reality of the climatic fluctuations, though they still leave the absolute level of the early part of the record in some doubt. These curves point to a rapid increase of rainfall about 850 B. C. This evidently corresponds with the formation of the modern Lakes Pyramid and Winnemucca; about that date the rainfall must have increased from less to more than its present value, and we can adjust the level of Antevs's curves accordingly. Various other points can be determined from a study of the terraces formed during different stages in the history of these and other lakes; for example, the salt content of Owens Lake shows that it became fresh rather more than 2,000 years ago, in this case by rising to such a high level that it overflowed, indicating that a peak on the corrected tree-growth curve at 450 B. C. was the absolute maximum of the whole curve. The age of Lake Walker is estimated as 800 to 900 years, and it can be shown that this lake originated with some changes in the drainage during a period of increased rainfall. A peak on the tree-growth curve fixes this maximum, second only to that of 450 B. C., at A. D. 1000. The corresponding high-level beach can be recognized in the Lahontan Basin, and we find that between these two maxima sub-aerial deposits extended below the present level of Lakes Pyramid and Winnemucca, pointing to a rainfall below the present; the tree curve dates this as A. D. 650 to 850. Finally, a tree killed by the rising salt water of Lake Mono was 500 years old, showing that the rainfall has been slight since A. D. 1400.

This comparison of two different sets of data gives a rainfall curve which can apparently be accepted with a good deal of confidence. Huntington, however, adopts a different interpretation; he considers that the long dry period preceding the formation of Lakes Pyramid and Winnemucca is the American representative of his Caspian drought of A. D. 650, and to make the dates fit he arbitrarily reduces Jones's determination of the age of these lakes by one-half. He states that "that is the earliest time when there is any evidence of so dry a period within historic times;" but it happens that there is abundant evidence of a prolonged dry period in Europe ending in 850 B. C., agreeing remarkably well with the combined evidence of the lakes and the trees in America.—*Nature, February 23, 1926.*

[1] "Quaternary Climates: Geologic History of Lake Lahontan," by J. Claude Jones; "On the Pleistocene History of the Great Basin," by Ernst Antevs; "The Big Tree as a Climatic Measure," by Ernst Antevs; "Tree Growth and Climatic Interpretations," by Ellsworth Huntington. (Publication No. 352.) Pp. v+212+10 plates. (Washington: Carnegie Institution, 1925.)

METEOROLOGICAL SUMMARY FOR SOUTHERN SOUTH AMERICA, JANUARY 1926

By Señor J. B. NAVARRETE

[El Salto Observatory, Santiago, Chile]

(Translated by B. M. V.)

The month of January was characterized by relatively stable atmospheric conditions. During the first half, there were frequent pressure changes in the south, but on the other hand an anticyclone central at Chiloe dominated the situation almost without interruption during the second half.

Between the 1st and 3d a depression lay over the southern region, causing local showers between Valdivia and Magallanes. On the 4th the pressure rose in the south putting an end to the bad weather, but on the 5th it began to decrease again and between the 6th and 10th a period of bad weather with rains occurred between Valdivia and Chiloe. The greatest daily precipitation, 35 mm., was recorded at Valdivia on the 7th. After a transition period of calm on the 11th and 12th on the 13th it rained again between Concepcion and Magallanes, 38 mm. falling at Valdivia.

On the 14th, pressure rose decidedly in the south, becoming fully developed on the 15th, after which a major anticyclone became established at Chiloe, Huafo, and Raper, and lasted until the end of the month, with generally fine weather, prevailingly southerly winds, and in the central zone intense hot waves. The highest temperature observed in this zone, 37° C., occurred at Talca on the 25th.

METEOROLOGICAL SUMMARY FOR BRAZIL, JANUARY, 1925

By J. de SAMPAIO FERRAZ

Six anticyclones affected the country in this month. Generally, their tracks continued abnormal, running in the east northeasterly direction, with centers delayed off the coast. The continental depression was particularly active from the 7th to the 14th and from the 17th to the 19th, more so in the first period.

Rainfall distribution corresponded to the abnormal aspects of the synoptic charts. Except Rio Grande do Sul, well in the tracks of the highs, all the other southern and central States had abundant rainfall. The lagging of anticyclonic centers off the coast, from Rio up to S. Catharina, with the continental depression in contact with them brings heavy precipitations between the two systems and well within the area of low pressures.

From Bahia northward, rainfall was generally scarce except in Maranhao. From the Amazon no observations were received in time for the summary.

The weather in Rio de Janeiro was very unsettled throughout the month, with frequent showers. Maximum temperatures were unusually low, two degrees on the average under normal value. On the 16th and 24th the city was struck by fresh southern winds.

Crops generally did well but lack and excess of rainfall have not been favorable to many of them. Wheat suffered most from excessive precipitation and consequent rust.

A CORRECTION

About "Fluctuations in the values of the solar constant" (Mo. Wea. Rev., **53**: 519–521): Dr. Götz, of Arosa, draws my attention to my not having mentioned his note in the *Astronomische Nachrichten* 221, 335, No. 5300, which, I am sorry, so far has remained unknown to me and which reports about extraordinary atmospheric-optical observations of the 22nd and 23rd January 1922 (telluric solar corona, abnormal distribution of illumination, upper-cirri, diminished solar radiation) and brings them into relation with the observations summarized by Prof. Wolf in the *Astronomische Nachrichten*, 5249, as possible consequences of the Chilean volcanic eruption.—*C. Dorno.*

BIBLIOGRAPHY

C. FITZHUGH TALMAN, in Charge of Library

RECENT ADDITIONS

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies.

Baur, Franz.
Grundlagen einer Vierteljahrstemperaturvorhersage für Deutschland. Braunschweig. 1926. 39 p. 31 cm.

Carnegie institution of Washington. Dept. of terrestrial magnetism.
Ocean magnetic and electric observations, 1915–1921. Magnetic results, by J. P. Ault. Atmospheric-electric results, by J. P. Ault and S. J. Mauchly . . . Washington. 1926. vii, 430 p. illus. 15 plates (incl. front., maps). diagrs. 30 cm. (Researches of the Department of terrestrial magnetism. v. 5.)

Čzechoslovakia. Hydrologická služba.
Přehledná zpráva o pozorování sněhu . . . za zimní období 1924–1925. Rapport général des observations nivométriques dans la République Tchécoslovaque pendant l'hiver 1924–1925. Praze. 1925. unp. plates. map (fold.) 25½ cm.

Gibbs, William Edward.
Clouds and smokes, the properties of disperse systems in gases and their practical applications . . . London. 1924. xiii, 240 p. illus. plates. diagrs. 22½ cm.

Grabham, G. W., & Black, R. P.
Report of the mission to Lake Tana 1920–1921. Cairo. 1925. xix, 207 p. plates (part fold.) 34 cm. (Min. pub. works, Egypt.)

Great Britain. Meteorological office. International meteorological organization.
Commission for the exploration of the upper air. Report of the meeting in London, April 16–22, 1925. London. 1925. 79 p. fig. plates. 24½ cm. (M. O. 281.)

Gregg, Willis Ray.
In the aerial ocean. p. 8–10. illus. 30 cm. [Western flying, v. 1, no. 2, Feb., 1926.]

Guitton, Raoul.
Étude sur le climat de Bastia. p. 234–277. figs. 25 cm. [Bull. de la Soc. sci. hist. & natur. de la Corse. Bastia. 1924. 44e année. 3d trim. 1924.]

Hurst, H. E.
Lake plateau basin of the Nile. Cairo. 1925. v, 75, 4 p. plates (part fold.) map. 28½ cm. (Min. pub. works, Egypt. Phys. dept. paper no. 21.)

International geodetic and geophysical union. Section of terrestrial magnetism and electricity.
Transactions of Madrid meeting, October, 1924, edited by Louis A. Bauer . . . November, 1925. Baltimore. [1925.] viii, 180 p. figs. 25 cm.

Italy. Servizio idrografico.
Osservazioni pluviometriche raccolte nel quinquennio 1916–1920. Roma. 1925. viii, 155 p. 34 cm. (Pubbl. N. 1, Serv. idrog. v. 5. Bacino del Po. Ordinate Filippo Eredia.)

Kidson, Edward.
1. Some periods in Australian weather. 2. Observations of visibility at various Australian stations during 1923 and 1924. 3. Atmospheric pollution: observations with the Owens' dust-counter during 1923 and 1924. [Melbourne. 1925.] 50 p. figs. 31 cm. (Comm. of Australia. Bur. of met'y, Melbourne. Bull. no. 17.)

McAdie, Alexander George.
War weather vignettes. New York. 1925. 62 p. front. plates. 22½ cm.

Marinelli, G[iuseppe.]
La meteorologia e la unificazione delle rotte transatlantiche. Roma. 1925. 29 p. charts. 24½ cm. (Estr.: Rivista marittima. Dic., 1925.)

Niblack, A. P.
Summary of data on uniformity in storm warning signals. Cannes. 1925. 17 p. plates. 27½ cm.

Poisson, Ch.
Normales météorologiques de Tananarive. p. 59–63. 28½ cm. [Bulletin économique.]
Un problème de météorologie tropicale. Louvain. 1925. 30 p. 25 cm. (Extr.: Revue des questions scientifiques, juil., 1925.)

Rossby, Carl-Gustaf.
Den Nordiska aerologiens arbetsuppgifter. En återblick och ett program. p. 364–376. figs. 23½ cm. (Svenska sällskapet för antropologi och geografi. Ymer. Årg. 1923, H. 3.)

Schmid, Josef.
Klima, Boden und Baumgestalt im beregneten Mittelgebirge. Ein Beitrag zum Wasserhaushalt und zur Oberflächengestaltung. Neudamm. 1925. 133p. illus. plates (part fold.) 24 cm.

Schulz, Bruno.
Hydrographische Untersuchungen. B. Beiträge zur Kenntnis der Gezeiten an der flandrischen Küste und auf der unteren Schelde. Hamburg. 1925. 63 p. illus. plates (part fold.) 29 cm. (Deutsche Seewarte. Aerol. und hydrog. Beobacht. der deutschen Marine-Stationen während der Kriegszeit 1914–1918. H. 2.)

Sherwood, George H.
Big tree and its story. The Sequoia and the history of biological science. New York. 1924. 31 p. illus. 25 cm. (Amer. mus. nat. hist. Guide leaflet no. 42.) [Climate and history as recorded by the big trees, p. 25 fig.]

Slettenmark, Gustaf.
De Svenska flodernas vattenmängder. Stockholm. 1925. 56 p. plates. 31½ cm. (Meddelanden från Statens meteorologisk-hydrografiska anstalt. Bd. 3, No. 5.)

Störmer, Carl.
Aus den Tiefen des Weltenraums bis ins Innere der Atome. Leipzig. 1925. 195 p. illus. 19½ cm.

Van den Broeck, A.
Het weerbericht van het Koninklijk meteorologisch instituut van België in 1925. Brussel. 1925. iii, 22 p. illus. 32 cm. (K. Met. inst. van België. Verhandelingen. Boekd. 1.)

RECENT PAPERS BEARING ON METEOROLOGY

The following titles have been selected from the contents of the periodicals and serials recently received in the library of the Weather Bureau. The titles selected are of papers and other communications bearing on meteorology and cognate branches of science. This is not a complete index of all the journals from which it has been compiled. It shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau

American botanist. Joliet. v. 32. January, 1926.
Frost-weeds. p. 18–21. [Abstr. art. by Humphreys.]

American meteorological society. Bulletin. Worcester, Mass. v. 7. January, 1926.
Alexander, W. H. A droughty year (1925) with bumper crops (in Ohio). p. 14–16. [Astract.]
Fergusson, S. P. Strongest wind on record in the United States. p. 17–19.
Flora, S. D. Tornadoes of the Middle West. p. 13–14. [Abtract.]
Gregg, W. R. Upper air winds of central and eastern United States. p. 10–11. [Abstract.]
Pitman, Geo. W. Weather and potatoes in Wyoming. p. 14. [Abstract.]
Riley, John A. The wind factor and the air mail southward from Kansas City. p. 11–12. [Abstract.]
Woolard, Edgar W. Thermodynamics for the meteorologist. p. 19–20.

American society of heating and ventilating engineers. Journal. New York. v. 32. February, 1926.
Hartman, F. E. Has air a vital property? p. 67–72.

Annalen der Hydrographie und maritimen meteorologie. Berlin. 53. Jahrgang. Oktober, 1925.
Arnold-Alabieff, W. Die Eisverhältnisse im Finnischen Meerbusen während den Winter 1922 bis 1925 in Verbindung mit der Eisbrechertätigkeit. p. 312–318.
Petersen, P. Die Eisverhältinisse des Winters 1924/25 in den ausserdeutschen europäischen Gewässern. p. 319–326.
Speerschneider, C. J. Eisbildung und Eismeldedienst in dänischen Fahrwassern. p. 305–312.

Astronomie. Paris. 40. an. Janvier 1926.
Cabannes, J., & Dufay, J. Mesure de l'altitude de la couche d'ozone dans l'atmosphère. p. 34–36. [Repr. Comptes rendus.]

Astrophysical journal. Chicago. v. 63. January 1926.
Menzel, Donald H. The atmosphere of Mars. p. 48–59.

British association for the advancement of science. Report of the 93d meeting. Southampton. 1925.
Brunt, D. Periodicities in weather. p. 300. [Abstract.]
Johnson, N. K. A study of the vertical gradient of temperature in the atmosphere near the ground. p. 300. [Abstract.]
Shaw, *Sir* **Napier.** Trigger action in the atmosphere. p. 298. [Abstract.]
Simpson, G. C. The new ideas in meteorology. p. 15–29.

France. Académie des sciences. Comptes rendus. Paris. t. 182. 1926.
Buisson, H., & Jausseran, C. Sur les variations de l'ozone de la haute atmosphère. p. 232–234. (18 janv.)
Dufay, Jean. Polarisation de la lumière du ciel nocturne. p. 331–333. (1 fév.)

Franklin institute. Journal. Philadelphia. v. 201. February, 1926.
Swann, W. F. G. The origin of the earth's electric and magnetic phenomena. p. 143–176.

Geografiska annaler. Stockholm. Årg. 7. H. 3. 1925.
Afzelius, Gretl. Vieljährige Niederschlagsschwankungen im Umkreis der Alpen. p. 222–246. [Finds a period of about 34 years.]

Hygeia. Chicago. v. 4. March, 1926.
Hinsdale, Guy. A change of climate. p. 130–132.

Japanese journal of physics. Transactions and abstracts. Tokyo. v. 4. no. 1. 1925.
Nisi, Hisamitu. Experimental studies on eddies in air. p. 1–11.

Journal of geophysics and meteorology. Moscow. v. 1. no. 2. 1924.
Federov, E. Some results of hourly observations of cloudiness in Slutzk. p. 164.
Fredrics, G. The probable cause of the force of gravity. p. 194.
Isvekov, B. A new proof of the theorem of Bjerknes on circulation. p. 198.
Kalitine, N. On the possibility of application of Violle-Richards actinograph adapted as an integrator of solar and diffusive energy of radiation. p. 118.
Keller, L. Einige Betrachtungen über die Untersuchung des täglichen Ganges des spezifischen Volumens der Luft p. 105–106.
Khanevsky, W. Das gesammte System der Winde zwischen dem Aequator und dem 70ten Grade nördlicher Breite. p. 155–156.
Petelin, M. Numerical prediction of barometric values by means of isallobaric charts. p. 202.
Roschdestwensky, A. Ueber die Veränderung des Reductionskoeffizienten für die Windgeschwindigkeit an der meteorologischen Station des Physikalischen Zentral Observatoriums zu Leningrad nach Beobachtungen von 1903 und 1919. p. 128.
Wegener, Kurt. Ueber künstliche Regenerzeugung. p. 165–167.
Weinberg, B. De l'application de la formule de M. A. Velikanoff (donnant la distribution de la vitesse d'un courant d'eau dans un canal d'après la verticale) à la distribution de la vitesse du vent d'après la hauteur. p. 96.
Welikanoff, M. Ueber die turbulente Strömung zäher Flüssigkeiten. p. 186–188.

Journal of scientific instruments. London v. 3. January, 1926.
Ower, E. A low speed vane anemometer. p. 109–112.

Marine observer. London. v. 3. March, 1926.
Garbett, L. G. Upper-air observations over the sea. p. 45–48.

Meteorological magazine. London. v. 61. February, 1926.
Bilham, E. G. The optics of the sunshine sphere. p. 1–5.
Brooks, C. E. P. Climatic changes in America. p. 11–13.
The deterioration of climate in Greenland. p. 13–14.
G[lobe], E. Wireless weather reports from Greenland. p. 10–11.
Ping, A. Wentworth. Smoking snow. p. 8–9.
Portable receiver for the electric cup anemometer. p. 14.
Russell, Spencer. "A red sky at night . . ." p. 15–17.
Salter, Mortyn J. Possible errors in annual rainfall totals obtained by the summation of daily records. p. 9–10.

Meteorologische Zeitschrift. Braunschweig. Band 42. Dezember 1925.
Albrecht, Fritz. Das geheizte Haarhygrometer als Messgerät des Wassergehaltes von Wolken und Nebeln. p. 468–477.
Conrad, V. Homogenitätsbestimmung meteorologischer Beobachtungsreihen. p. 482–485.
Ficker, H. v. Zur Austrocknung Innerasiens. p. 481–482.
Götz, F. W. Paul. Der Trübungsfaktor getrennter Spektralbereiche. p. 477–481.
Groissmayr. Über die Erhaltungstendenz der mittleren monatlichen Temperaturanomalien. p. 489–491.
Köhler, Hilding. Über Tropfengruppen und einige Bemerkungen zur Genauigkeit der Tropfenmessungen, besonders mit Rücksicht auf Untersuchungen von Richardson. p. 463–467.
Kölzer, Joseph. Die Schallausbreitung in der Atmosphäre und die äussere Hörbarkeitszone. p. 457–463.
Korselt, E. Über die Störungen der regelmässigen täglichen Luftdruckschwankungen durch Sonnenfinsternisse. p. 485–487.
Peppler, W. Extremwerte der relativen Feuchtigkeit und die Schichtung in der Troposphäre. p. 487–489.
Pödder, Arnold I. Die durchschnittliche Wanderungsgeschwindigkeit der barometrischen Minima in Siberien. p. 491–492.

National academy of sciences. Proceedings. Washington, D. C. v. 12. January, 1926.
Millikan, R. A. High frequency rays of cosmic origin. p. 48–55.
Roebuck, J. R. The Joule-Thomson effect in air. p. 55–58.

Nature. London. v. 117. 1926.

Climate changes in western America. p. 238–239. (Feb. 13.) [Reviews papers by Antevs and Huntington on tree rings and climate.]

Hobbs, William Herbert. Greenland or polar front. p. 232–233. (Feb. 13.)

Stewart, C. D. Weather prediction from observation of cloudlets. p. 270. (Feb. 20.)

Nature. Paris, 54 année. 1926.

Mercanton, P.-L. Encore le "rayon vert." suppl. p. 49. (13 février.)

Mascart, Jean. Témoignage de la faune dans les modifications du climat. p. 142–143. (27 février.)

Nature magazine. Washington, D. C. v. 7. March, 1926.

Christman, W. W. Volcanoes of foam. p. 144. [Describes conical formations of frozen foam over breaks in ice covering a stream.]

Schoonhoven, John J. Red snow. p. 148.

Naturwissenschaften. Berlin. 14. Jahrgang. 8. Januar 1926.

Schubert. Verdunstung und Dampfmangel im Flach- und Berglande, in Nadel- und Buchenwäldern. p. 32. [Abstract.]

Observatoire géophysique central. Recueil de géophysique. Leningrad. t. 4. fascicule 3. 1925.

Berg, E. Exzessive Regengüsse verschiedener Dauer im Europäischen Russland im Jahrzehnt 1903–1912. p. 9–27.

Kalitine, N. N. La transparence de l'atmosphère d'après les observations faites à Sloutzk (Pavlovsk). p. 49–86.

Savinov, S. J. The anomaly of temperature of 1924–25 according to the observations effected at the Magnetic meteorological observatory in Slouzk (Pavlovsk). p. 99–110.

Schoenrok, A. Zahl der Frosttage und der Wintertage im Europäischen Russland. p. 28–48.

Shostakovitch, W. B. The snow cover in eastern Siberia. p. 111–123.

Wiese, W. Über die langfristige Vorhersage der Menge des Niederschlages in den zentralen und östlichen Teilen Russlands im April und Mai. p. 87–98.

Philosphical magazine. London. v. 1. February 1926.

Brunt, D. Energy in the earth's atmosphere. p. 523–532.

Nolan, P. J. The character of the ionization produced by spraying water. p. 417–428.

Physical review. Minneapolis. v. 27. February, 1926.

Taylor, A. Holt, & Hurlburt, E. O. The propagation of radio waves over the earth. p. 189–215.

Physico-mathematical society of Japan. Proceedings. Tôkyô. v. 8. January 1926.

Nukiyama, Daizo, & Nakata, Kin'iti. Atmospheric potential in lower stratum of atmosphere. p. 5–14.

Physikalische Zeitschrift. Leipzig. 27. Jahrgang, no. 2. 1926.

Kolhörster, Werner. Apparat zur Messung der durchdringenden Strahlung. p. 62–63.

Pontificia accademia delle scienze nuovi Lincei. Atti. Roma. Anno 77. 1924.

Martinelli, G. Due eccezionali depressioni barometriche sull' Italia. p. 82–85. (Sess II^a. 20 gennaio.)

Palazzo, Luigi. Marco Dechevrens. p. 157–158. (Sess. VI^a–VII^a. 18 maggio–15 giugno.) [Obituary.]

Popular astronomy. Northfield, Minn. v. 34. March, 1926.

Petersen, Max. The shadow bands. p. 217–218.

Prussia. Meteorologisches Institut. Abhandlungen. Berlin. Band 8, Nr. 1. 1925.

Gessler, R. Die Stärke der unmittelbaren Sonnenbestrahlung der Erde in ihrer Abhängigkeit von der Auslage.

Revue générale des sciences. Paris. 37 an. 21. janvier 1926.

Mascart, Jean. Les chotts algériens et le climat africain. p. 35–37.

Royal astronomical society of London. Monthly notices. v. 86. January 1926.

Turner, H. H. On a period of approximately 9.2 years in the Greenwich observations of magnetic declination and horizontal force. p. 108–118.

Turner, H. H. On an unsuccessful search for the 9.2-year magnetic period in sunspot records, with a new analysis of those records back to 1610. p. 119–130.

Science. New York. v. 63. March 12, 1926.

Hobbs, William Herbert. Arctic explorations and the origin of storms. suppl. p. x.

Scientific monthly. New York. v. 22. March, 1926.

Aldrich, L. B. Studying the sun in Chile. p. 258–261.

Fairchild, Herman L. Changing levels of the Great Lakes. p. 193–199.

Humphreys, W. J. Winter's music. p. 215–217.

Sociedade de geografia. Boletim. Lisboa. 40ª serie. Julho-setembro de 1922.

Lima, Almeida. O problema de locomoção aérea e o serviço aerológico em Portugal. p. 320–322.

Washington academy of sciences. Journal. Baltimore, Md. v. 16. 1926.

Austin, L. W. The present status of radio atmospheric disturbance. p. 41–46. (Jan. 19.)

Fergusson, S. P. Meteorology of the total solar eclipse of January 24, 1925. p. 46–48. (Jan. 19.)

Dorsey, N. Ernest. A lightning stroke. p. 87–93. (Feb. 19.)

Fleming, J. A. The magnetic and electric survey of the earth: Its physical and cosmical bearings and development. p. 109–132. (March 4.)

Wetter. Berlin. 43. Jahrgang. Januar 1926.

Diesner, P. Der Geltungsbereich klimatologischer Stationen. p. 21–24.

Meissner, Otto. Bemerkenswerte Witterungsereignisse der letzten 10 Jahre (1916–1925). p. 17–21.

Peppler, Albert. Die Meteorologie an den deutschen Hochschulen. p. 1–15.

SOLAR OBSERVATIONS

SOLAR AND SKY RADIATION MEASUREMENTS DURING FEBRUARY, 1926

By HERBERT H. KIMBALL, Solar Radiation Investigations

For a description of instruments and exposures and an account of the method of obtaining and reducing the measurements, the reader is referred to the REVIEW for January, 1924, **52**:42, January, 1925, **53**:29, and July, 1925, **53**:318.

From Table 1 it is seen that solar radiation intensities averaged slightly above February normals at all three stations except for a. m. observations at Lincoln.

Table 2 shows that the total solar and sky radiation received on a horizontal surface averaged below normal for all four weeks at the three stations for which normals have been determined.

No skylight polarization measurements were obtained at Madison, as the ground was covered with snow throughout the month. Measurements made on five days at Washington give a mean of 58 per cent with a maximum of 60 per cent on the 25th. These are close to the February averages for Washington.

TABLE 1.—*Solar radiation intensities during February, 1926*

[Gram-calories per minute per square centimeter of normal surface.]

WASHINGTON, D. C.

Date	Sun's zenith distance										
	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e.	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e.
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
Feb. 5	2.26	0.72	0.87	1.07	1.34	......	1.33	1.20	......	......	2.16
11	1.52	......	......	......	1.07	......	......	......	......	......	1.45
16	1.96	......	0.75	0.93	1.09	......	1.22	0.98	......	......	2.26
17	2.74	0.64	0.79	0.92	1.18	......	......	......	......	......	3.00
20	1.68	0.63	0.84	0.96	1.20	......	......	......	......	......	2.62
23	3.45	......	......	......	......	......	1.38	1.17	0.92	0.80	2.16
24	1.96	0.66	0.82	0.95	1.07	......	......	......	......	......	2.26
26	3.00	0.92	1.00	1.16	1.25	......	......	......	......	......	3.30
Means	......	0.71	0.84	1.00	1.17	......	1.31	1.12	(0.92)	(0.80)	......
Departures	......	±0.00	+0.03	+0.02	+0.01	......	+0.12	+0.15	+0.08	+0.04	......

TABLE 1.—*Solar radiation intensities during February, 1926*—Con.

Date	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	Sun's zenith distance										
	75th mer. time	Air mass A. M.					P. M.				Local mean solar time
	e.	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e.
MADISON, WIS.											
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Feb. 15	1.32	1.04	1.15	1.29		1.60					1.68
19	1.19		1.11	1.27	1.46	1.67					1.52
23	1.96	0.71	0.78								3.00
26	2.26				1.38						2.16
27	1.32	1.07	1.17	1.28	1.44	1.60					1.78
Means		0.94	1.05	1.28	1.43	1.62					
Departures		±0.00	−0.06	+0.04	+0.06						
LINCOLN, NEBR.											
Feb. 6	4.17			1.25	1.41						5.16
7	3.99						1.41	1.30			6.02
9	3.81	1.09	1.21	1.34		1.62	1.46	1.31	1.19	1.07	3.99
12	4.57	0.90	1.02	1.17	1.34	1.54	1.32	1.20	1.06	0.93	6.27
15	1.96	0.72	0.93	1.10	1.22		1.39	1.14	1.10	0.96	2.74
22	3.15						1.28	1.14	1.00	0.84	3.81
23	3.81			1.09	1.30						3.81
27	3.63				1.23						4.37
28	3.99			1.14	1.30						4.95
Means		0.90	1.05	1.18	1.30	1.58	1.37	1.22	1.09	0.95	
Departures		−0.05	+0.01	−0.02	−0.08		+0.02	+0.05	+0.06	+0.04	

*Extrapolated.

TABLE 2.—*Solar and sky radiation received on a horizontal surface*

[Gram-calories per square centimeter of horizontal surface]

Week beginning—	Average daily radiation: Washington	Madison	Lincoln	Chicago	New York	Average daily departure from normal: Washington	Madison	Lincoln
1926	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
January 29	120	104	145	44	66	−78	−96	−100
February 5	159	163	251	48	132	−57	−54	−16
12	218	176	263	54	104	−16	−63	−31
19	241	196	266	83	108	−17	−63	−53
Deficiency since first of year on Feb. 25						−1,190	−2,212	−2,191

WEATHER OF NORTH AMERICA AND ADJACENT OCEANS

NORTH ATLANTIC OCEAN

By F. A. YOUNG

February was another unusually stormy month over the North Atlantic. The percentage of days with gales was considerably above the normal over the middle and western sections of the steamer lanes, where they were reported on from 7 to 9 days, the storm area on a number of days extending as far south as the 35th parallel. The conditions over the eastern section of the northern steamer lanes were moderate as compared with the two previous months, although that region was by no means free from heavy weather. A number of reports were received from vessels indicating winds of force 11 and 12, although they were not quite as common as in January, and the number of marine casualties was also less.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressures at sea level, 8 a. m. (75th meridian), North Atlantic Ocean, February, 1926*

Stations	Average pressure	Departure [1]	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
St. Johns, Newfoundland	29.47	−0.35	30.10	15th	28.64	12th.
Nantucket	29.79	−0.27	30.28	17th	29.16	[2] 4th.
Hatteras	29.97	−0.16	30.46	17th	29.54	10th.
Key West	30.09	+0.01	30.30	28th	29.84	10th.
New Orleans	30.08	−0.02	30.36	20th	29.82	[2] 14th.
Swan Island	29.94	−0.05	30.06	20th	29.86	[2] 10th.
Turks Island	30.08	0.00	30.16	[2] 6th	29.94	11th.
Bermuda	30.06	−0.08	30.46	18th	29.50	11th.
Horta, Azores	30.04	−0.09	30.56	28th	29.42	4th.
Lerwick, Shetland Islands	29.71	−0.01	30.23	28th	29.02	17th.
Valencia, Ireland	29.66	−0.24	30.66	28th	28.97	1st.
London	29.87	−0.13	30.58	28th	29.27	3d.

[1] From normals shown on H. O. Pilot Chart, based on observations at Greenwich mean noon, or 7 a. m., 75th meridian.
[2] And on other dates.

Fog was unusually prevalent off the New England coast and in the Gulf of Mexico, while the number of days on which it occurred was about normal in the vicinity of the British Isles, and somewhat below over the Grand Banks and steamer lanes.

Low pressure prevailed at practically all of the stations during the greater part of the month, although at Horta there were two short periods in the second and third decades, respectively, when the barometric readings were considerably above normal, indicating that the North Atlantic HIGH was well developed.

Charts VIII to XIII show the conditions from the 1st to 6th, inclusive. During the first part of this period the same disturbance shown on Charts X and XI for January covered the eastern section of the steamer lanes. The LOW that was central near St. Johns, Newfoundland, on the 6th, as shown on Chart XIII, moved steadily eastward, and on the 7th the center was near 45° N., 40° W., and moderate to strong gales prevailed over the region between the 35th and 50th parallels and the 35th and 50th meridians. The LOW that was off the coast of Ireland on the 6th moved but little, decreasing in intensity, as on the 7th moderate weather prevailed over the eastern section of the steamer lanes, although on that date and the 8th vessels between the Azores and the Spanish coast reported moderate southwesterly gales.

On the 8th there was a slight depression off Hatteras that afterward developed into a severe disturbance. On that date there was also a LOW central near 50° N., 40° W., and strong gales swept the steamer lanes between the 30th and 50th meridians. The Hatteras disturbance moved northeastward along the coast, and on the 10th was near Nantucket. On the 11th it was near Halifax, while on both of these dates southwesterly to north-

westerly gales occurred between the 65th meridian and the American coast, and on the 11th storm logs were also rendered by vessels in the vicinity of the Bermudas.

On the 12th the coast disturbance was central near St. Johns, with westerly gales west of the 35th meridian, extending as far south as the 30th parallel. On the 13th the center of this LOW was near 50° N., 40° W., and the storm area covered the greater part of the ocean between the Azores and the Bermudas, extending over the eastern section as far north as the 50th parallel.

On the 14th there was a slight depression off the Virginia Capes that increased in intensity as it moved northeastward. On the 15th the center was near Nantucket, and on that date moderate westerly gales prevailed along the coast between Hatteras and Nova Scotia, while southerly winds of gale force were reported by vessels as far east as the 50th meridian. On the 14th and 15th strong westerly to southwesterly gales were also encountered over the eastern section of the steamer lanes.

On the 16th St. Johns was again near the center of a LOW, with gales in the southern and eastern quadrants, the storm area extending to the 30th parallel and 35th meridian, respectively, while moderate weather was the rule over the remainder of the ocean. This LOW moved but little during the next 24 hours, and on the 17th was still central near St. Johns, and strong westerly gales prevailed between the Bermudas and the 45th parallel, while conditions over the eastern section of the steamer lanes differed but little from those of the previous day.

On the 18th the St. Johns disturbance was central near 47° N., 42° W., and the storm area covered the region between the 35th and 50th parallels and the 40th and 55th meridians, and storm reports were received from a few vessels in the vicinity of the Azores and the eastern section of the steamer lanes.

The daily weather map of the 19th shows a LOW central near Washington, D. C., and on that date southerly gales were reported along the American coast south of the Virginia Capes, and westerly gales in the Gulf of Mexico. On this date the northern LOW was central near 48° N., 35° W., and the storm area extended from the 35th to 50th parallels, east of the 45th meridian.

On the 20th Belle Isle was near the center of an active disturbance, and strong gales prevailed over the region west of the 40th meridian, extending as far south as the 30th parallel. The northern LOW of the 18th and 19th was now central near 45° N., 20° W., and while a few storm reports were received from vessels in the eastern section of the steamer lanes, favorable weather was the rule in that region.

The Belle Isle LOW moved steadily eastward, and on the 21st was over the central section of the steamer lanes. The storm area over the western section of the ocean had contracted considerably since the previous day, and moderate weather was the rule west of the 60th meridian.

On the 22d areas of low pressure surrounded both Belle Isle and Nantucket, and moderate westerly gales occurred off the American coast between Hatteras and the Virginia Capes, while the steamer lanes between the 30th and 60th meridians were swept by westerly winds that at times reached hurricane force.

By the 23d the two LOWS had apparently joined forces, and the combined LOW was now central near 50° N., 40° W. The weather had moderated considerably, as the storm area covered only a comparatively small part of the middle section of the steamer lanes. This LOW moved steadily northeastward, and on the 24th was undoubtedly in the vicinity of Iceland, although it was impossible to locate its position accurately due to lack of observations. On this date vessels near 55° N., 25° W., encountered southwesterly winds of force 11 and 12, although the storm area had contracted since the previous day.

The weather map of the 25th shows a deep depression central over lower Lake Michigan, with a barometer reading of 28.90 inches at Milwaukee. The influence of this LOW extended to the Atlantic coast, where southerly winds of gale force prevailed between Norfolk and Charleston. On this date, conditions over the eastern section of the ocean had moderated since the previous day, although winds of moderate gale force were reported east of the 30th meridian, as well as from land stations on the British Isles.

On the 26th Eastport, Maine, was the center of a depression, and strong southerly gales were encountered between the 55th meridian and the American coast, while moderate weather prevailed over the remainder of the ocean. This LOW moved northeastward, and on the 27th was near Belle Isle, with southerly gales between the 40th and 55th parallels and 35th and 50th meridians. It moved but little during the next 24 hours, and the weather conditions had not changed materially, although on the 28th the storm area was of somewhat greater extent than on the previous day, and moderate northwesterly gales were reported from vessels between the Bermudas and the American coast. On the 28th there was an area of unusually high pressure near 47° N., 15° W., with a crest of over 30.70 inches.

OCEAN GALES AND STORMS, FEBRUARY, 1926

Vessel	Voyage		Position at time of lowest barometer		Gale began	Time of lowest barometer	Gale ended	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Highest force of wind and direction	Shifts of wind near time of lowest barometer
	From—	To—	Latitude	Longitude									
NORTH ATLANTIC OCEAN			° ′	° ′				Inches					
Conrad Mohr, Nor. S. S.	St. Rose	Hamburg	39 10 N.	55 43 W.	Feb. 1	8 a., 1st	Feb. 2	29.28	SW	SW., 8	E	SW., 10	
Cameronia, Br. S. S.	Glasgow	New York	54 31 N.	21 06 W.	Jan. 31	6 a., 1st	Feb. 4	[1] 27.85	ESE	SW., 6	WNW	NNW., 10	W.-WSW.
Homestead, Am. S. S.	Gibraltar	do	34 41 N.	20 14 W.	do	Mid., 1st	Feb. 2	29.68	SW	W., 9	NW	—, 11	W.-NW.
Steel Engineer, Am. S. S.	Port Said	Galveston	36 17 N.	10 44 W.	Feb. 1	9 a., 2d	Feb. 3	29.45	S	SW., 8	W	NW., 10	SW.-W.-NW.
S. B. Hunt, Am. S. S.	Baton Rouge	New York	35 35 N.	75 00 W.	Feb. 3	3 p., 3d	do	29.47	ESE	SE., 6	SE	—, 9	Steady.
Montpelier, Am. S. S.	Hamburg	do	30 15 N.	36 58 W.	do	4 p., 3d	do	29.31	WSW	W., 9	W	W., 9	WSW.-W.-N.
Virginia, Am. S. S.	Fall River	Port Arthur	40 24 N.	72 17 W.	do	4 a., 4th	Feb. 4	29.17	ESE	ESE., 6	NW	—, 11	ESE.-NW.
Nessian, Br. S. S.	Rotterdam	Boston	48 00 N.	26 51 W.	Feb. 4	Noon, 4th	Feb. 5	29.07	N	N., 9	N	N., 10	Steady.
Athelmere, Br. S. S.	Boston	Cuba	37 12 N.	69 30 W.	Feb. 3	do	do	29.14	ESE	WNW., —	NW	—, 12	W.-WNW.
Saparoea, Du. S. S.	Newport News.	Port Said	39 10 N.	63 10 W.	Feb. 4	1 a., 5th	do	28.69	WSW	WSW., 11	NW	WNW., 12	WSW.-WNW.
Beemsterdijk, Du. S. S.	Philadelphia	Lizard Head	48 40 N.	25 04 W.	do	2 a., 5th	Feb. 6	29.07	NW	NW., 7	NW	NNW., 9	NNW.-NW.
Clairton, Am. S. S.	Avonmouth	Baltimore	44 18 N.	47 27 W.	Feb. 5	8 a., 6th	do	28.65	SE	WSW., 8	NW	—, 10	WSW.-NW.
Manchester Spinner, Br. S. S.	Swansea	Portland, Me.	47 55 N.	36 10 W.	Feb. 6	5 p., 6th	Feb. 8	29.18	NW	W., 8	W	NNW., 11	NW.-SW.-NW.
Emanuel Nobel, Belg. S. S.	Rouen	New Orleans	43 25 N.	22 47 W.	Feb. 7	10 p., 7th	do	29.33	WNW	WNW., 8	NW	—, 10	
Hessen, Ger. S. S.	Cristobal	Hamburg	37 34 N.	44 36 W.	Feb. 8	7 p., 8th	Feb. 9	29.67	SSW	SSW., 11	WNW	SSW., 11	SSW.-WNW.
Atlanta City, Am. S. S.	New York	Cristobal	34 10 N.	74 01 W.	Feb. 9	10 p., 9th	Feb. 11	29.37	WSW	SW., 10	WNW	SW., 10	SSW.-WSW.
Baron Sempill, Br. S. S.	Cuba	Philadelphia	37 35 N.	74 50 W.	Feb. 10	4 a., 10th	Feb. 10	29.14	SW	SW., 10	W	SW., 10	SW.-W.
Anniston City, Am. S. S.	Avonmouth	Baltimore	36 02 N.	51 02 W.	do	—, 11th	Feb. 14	29.20	SW	W., 9	NW	—, 10	SW.-W.-NW
Maine, Dan. S. S.	Barry Dock	Boston	43 00 N.	54 30 W.	Feb. 11	11 p., 11th	Feb. 12	28.66	S	W., —	N	—, 12	S.-W.-N.
Coldbrook, Am. S. S.	Antwerp	New Orleans	36 45 N.	38 00 W.	Feb. 12	10 p., 12th	Feb. 13	29.66	SSW	S., 10	WNW	WNW., 12	SSW.-WSW.
Adra, Br. S. S.	Cornwall	Portland, Me.	49 15 N.	27 00 W.	do	Noon, 12th	Feb. 15	29.12	S	S., 7	W	—, 10	SW.-SSW.
Dania, Dan. S. S.	Newcastle	Boston	47 10 N.	40 00 W.	do	7 a., 13th	do	28.63	S	W., 10	SW	W., 10	S.-W.
Aegir, Ger. S. S.	Rotterdam	Portland, Me.	50 20 N.	29 15 W.	Feb. 13	3 p., 13th	do	28.95	SSW	WSW, 10	NW	—, 11	
Bannack, Am. S. S.	Avonmouth	Baltimore	35 40 N.	69 20 W.	Feb. 14	Midt., 14th	do	29.77		SW., 9	NW	SSW., 9	SSW.-NW.
Effingham, Am. S. S.	Antwerp	Habana	45 15 N.	18 26 W.	Feb. 13	4 p., 14th	Feb. 14	29.67	SW	SSW., 9	SW	SSW., 9	SSW.-SW.
Binnendijk, Du. S. S.	Rotterdam	New York	41 11 N.	54 57 W.	Feb. 15	10 p., 15th	Feb. 17	29.24	WSW	SW., 9	NW	—, 9	SW.-NW.
Montpelier, Am. S. S.	Hamburg	do	35 53 N.	57 30 W.	Feb. 16	Noon, 16th	do	29.88	S	W., 7	NW	W., 10	SW.-W.-NW.
Adra, Br. S. S.	Cornwall	Portland, Me.	46 55 N.	38 50 W.	Feb. 17	9 a., 17th	Feb. 19	29.16	W	W., 7	WNW	—, 9	
Aegir, Ger. S. S.	Rotterdam	do	47 35 N.	42 30 W.	do	5 p., 18th	do	28.67	W	W., 11	NW	—, 12	
Muneric, Br. S. S.	Bluefields	New Orleans	28 00 N.	88 50 W.	Feb. 18	4 a., 19th	do	29.87	SSW	WNW., —		NW., 9	NW.-WNW.
Maracaibo, Am. S. S.	New York	La Guayra	35 20 N.	71 15 W.	Feb. 19	8 p., 19th	Feb. 20	29.43	SSW	WSW., 8	NW	W., 10	WSW.-W.
Montpelier, Am. S. S.	Hamburg	New York	38 07 N.	65 55 W.	do	4 a., 20th	do	29.37	SSW	SW., 9	NW	SSW., 10	SW.-W.-NW.
Tomalva., Am. S. S.	New York	Rotterdam	41 46 N.	46 58 W.	Feb. 20	8 p., 20th	Feb. 21	29.47	S	SSW., 11	NW	SSW., 11	SSW.-NW.
Hampton Roads, Am. S. S.	Las Piedras	New York	32 40 N.	73 47 W.	Feb. 21	9 p., 21st	Feb. 22	29.91	SW	WSW., 8	WSW	N., 9	
Suffren, Fr. S. S.	Havre	do	46 30 N.	33 25 W.	Feb. 22	3 a., 22d	Feb. 23	29.57	SW	SW., 10	WNW	—, 12	
Hoosac, Br. S. S.	Glasgow	St.John,N.B.	54 32 N.	24 30 W.	Feb. 23	8 p., 23d	Feb. 24	28.79	SW	SSW., 12	WNW	—, 12	SSW.-W.
Denham, Br. S. S.	Malaga	New York	39 40 N.	66 15 W.	Feb. 24	4 a., 24th	do	29.97	NW	NW., 9	NW	NW., 9	Steady.
Lucellum, Br. S. S.	N. Shields	do	55 28 N.	26 14 W.	Feb. 23	1 a., 24th	Feb. 25	29.17	S	WSW., 11	NW	WSW., 11	S.-W.-NW.
Bruges, Belg. S. S.	Antwerp	Savannah	32 15 N.	77 00 W.	Feb. 25	4 a., 25th	do	29.81	SSE	SE., 10	SW	SE., 10	
Satanta, Br. S. S.	Providence	Tampico	22 38 N.	95 40 W.	Feb. 26	3 p., 26th	Feb. 26	30.20	NNE	NNE., 7	N	N., 8	NW.-N.-NE.
Suffren, Fr. S. S.	Havre	New York	41 30 N.	58 00 W.	do	4 a., 26th	do	29.80	S	S., 11	SSW	—, 12	
Blijdendijk, Du. S. S.	Rotterdam	Boston	41 44 N.	54 52 W.	Feb. 27	10 p., 27th	Feb. 28	29.00	S	W., 10	W	W., 10	S.-W.
Oscar II., Dan. S. S.	Oslo	Halifax	48 10 N.	45 30 W.	Feb. 28	8 a., 28th	do	29.25	S	SSW., 9	WSW	SSW., 10	SSW.-W.
Nevisian, Br. S. S.	London	Boston	42 43 N.	46 04 W.	Feb. 26	5 p., 28th	do	29.49	SSW	SW., 10	WNW	—, 12	WSW.-NW.
Hoosac, Br. S. S.	Glasgow	St.John,N.B.	49 51 N.	41 45 W.	Feb. 27	8 a., 28th	Mar. 1	29.38	SW	S., 11	W	—, 12	S.-W.
NORTH PACIFIC OCEAN													
Stanley Dollar, Am. S. S.	San Pedro	Pearl Harbor.	27 43 N.	142 48 W.	Jan. 31	8 a., 1st	Feb. 1	29.60	S	W. 9	WNW	WNW., 11	
Hokkai Maru, Jap. S. S.	Miike	Columbia River.	46 27 N.	171 00 E.	Jan. 30	noon, 4th	Feb. 4	28.75	SSE	WNW	N	W., 10	WNW.-N.
City of Los Angeles, Am. S. S.	Wilmington	Honolulu	31 16 N.	130 10 W.	Feb. 1	noon, 1st	Feb. 2	29.50	S	S., 9	W	W., 10	
Carriso, Am. S. S.	Columbia River.	do	31 37 N.	141 24 W.	do	4 a., 1st	do	29.40	NW	NW., 10	W	NW., 10	SW.-NW.-W.
Niagara, Br. S. S.	Sydney, N. S. W.	Vancouver	43 00 N.	134 00 W.	do	midt., 2d	Feb. 4	28.91	WNW	S., 9	SSW	SW., 10	SE.-WSW.
Shidzuoka Maru, Jap. S. S.	Yokohama	Victoria	48 44 N.	129 55 W.	do	8 p., 2d	Feb. 3	28.79	NE	ESE., 8	S	SE., 10	
Dewey, Am. S. S.	Taku Bar	Columbia River.	44 56 N.	169 41 E.	Feb. 2	4 p., 4th	Feb. 4	28.71	W	NW., 6	W	W., 9	W.-NW.
Yuri Maru, Jap. S. S.	Houston	Yokohama	27 44 N.	162 08 W.	do	4 p., 6th	Feb. 6	29.74	WSW	SW	SW	WSW., 8	WSW.-NW.
Manukai, Am. S. S.	San Francisco	Honolulu	34 02 N.	133 43 W.	Feb. 1	9 a., 2d	do	29.34	SW	SW., 10	S	S., 11	SW.-S.
Pres. Taft., Am. S. S.	Honolulu	Yokohama	31 30 N.	175 38 E.	Feb. 2	4 a., 6th	do	29.40	W	W., 9	W	SW., 10	Steady.
Alabama Maru, Jap. S. S.	Yokohama	Victoria	50 40 N.	142 30 W.	Feb. 3	8 a	Feb. 3	*28.30		W., 8		—, 9	WNW.-SSW.
West Cajoot, Am. S. S.	Hongkong	San Francisco	35 40 N.	167 00 W.	do	10 a	do	29.19	SW	S., 10	W	S., 10	S.-SW.-W.
Gallier, Belg. S. S.	Portland	Panama	45 37 N.	126 12 W.	do	11 a., 4th	Feb. 5	29.29	SE	SE., 10	SSW	SE., 10	SE.-SW.-S.
Meton, Am. S. S.	Manila	Los Angeles	19 25 N.	120 30 E.	Feb. 4	11 p., 4th	Feb. 6	29.02	NE	NE	ENE	ENE., 8	NE.-ENE.
Tokiwa Maru, Jap. S. S.	Yokohama	Victoria	38 43 N.	146 45 E.	Feb. 5	6 a	Feb. 5	29.15	NE	NNE., 10	N	N., 11	NE.-N.-NNW.
Sabine Sun, Am. S. S.	Los Angeles	Philadelphia	9 50 N.	85 50 W.	Feb. 6	2 p., 6th	Feb. 7	29.80	NE	S	NNE	NNE., 8	
Erie Maru, Jap. S. S.	Wakamatsu	Long View, Oreg.	48 32 N.	135 37 W.	Feb. 7	8 a., 8th	Feb. 8	29.22	S	SSE., 8	SSW	S., 9	SSE.-S.
Pres. Cleveland, Am. S. S.	Yokohama	San Francisco	34 47 N.	150 41 E.	Feb. 10	6 a., 11th	Feb. 11	29.55	SSE	S., 10	NW	S., 10	S.-SSW.-WNW
Chateau Thierry, Am. S. S.	Honolulu	do	31 15 N.	133 04 W.	Feb. 11	2 a	do	29.18	SE	W., 12	W	W., 12	SE.-W.
Maunawile, Am. S. S.	Kanapali	do	36 13 N.	127 58 W.	do	8 a	do	29.32	E	E	E	—, 10	
West Holbrook, Am. S.S.	Hakodate	do	49 34 N.	171 01 E.	do	4 p., 12th	Feb. 12	29.11	SSE	SSE., 8	SSE	SSE., 9	Steady.
Pres. Jefferson, Am. S. S.	Seattle	Orient	46 20 N.	162 30 E.	do	4 p., 12th	Feb. 13	29.15	SSE	WSW., 10	WNW	WSW., 10	WSW.-W.
Akagisan Maru, Jap. S.S.	Yokohama	San Francisco	45 45 N.	147 45 W.	Feb. 12	4 a., 14th	Feb. 14	29.48	S	W., 6	WNW	—, 9	S.-SW.-W.
West Sequana, Am. S. S.	Hongkong	do	40 02 N.	172 30 W.	Feb. 15	2 p., 15th	Feb. 16	29.44	W	W., 9	W	W., 9	W.-NW.
Makiki, Am. S. S.	Puget Sound.	Honolulu	38 22 N.	141 18 W.	Feb. 17	3 p., 17th	Feb. 18	29.16	SW	SW., 6	NW	W., 10	SW.-W.
Hanley, Am. S. S.	Everet	Balboa	46 53 N.	124 45 W.	Feb. 18	2 a., 18th	Feb. 20	29.62	SE	SE., 10	SW	SE., 10	SE.-SW.
Esther Dollar, Can. S. S.	Karatsu	San Francisco	47 53 N.	175 42 W.	do	3 a., 21st	Feb. 21	29.16	W	S., 8	S	SE., 9	SE.-S.
Sucrosa, Am. S. S.	San Pedro	Philadelphia	15 40 N.	94 45 W.	Feb. 19	—, 21st	do	29.95	E	N., 10	NW	N., 10	NE.-N.
Arizonan, Am. S. S.	Los Angeles	Balboa	10 05 N.	85 54 W.	do	8 p., 21st	Feb. 22	29.91	NE	NE	ENE	—, 10	NE.-ENE.
Esther Dollar, Can. S. S.	Karatsu	San Francisco	47 34 N.	157 42 W.	Feb. 23	4 a., 24th	Feb. 24	29.24	E	E., 5	S	E., 10	E.-SE.-S.
West Jessup, Am. S. S.	Otaru	do	46 22 N.	163 16 E.	Feb. 26	4 a., 27th	Feb. 27	28.88	NW	NNW., 9	N	NNW., 9	Steady.
London Importer, Br. S. S.	Balboa	LosAngeles	13 10 N.	93 40 W.	Feb. 27		Feb. 28	29.84	NW	N., 7	N	N., 8	Steady.
Manchuria, Am. S. S.	San Francisco	Balboa	14 54 N.	96 28 W.	do	8 a., 27th	do	29.85	SE	SE., 1	NNW	NE., 10	NE.-NNW.
Corinto, Am. S. S.	Cristobal	San Francisco	15 30 N.	93 45 W.	do	3 p., 27th	do	29.89	NE	NE., 6	NNE	NE., 10	NE.-N.-NNE.

[1] Barometer reading doubtful.

* Uncorrected.

NORTH PACIFIC OCEAN

By WILLIS E. HURD

Following upon the abnormally low pressures observed in January over a considerable part of the North Pacific east of the 180th meridian, February witnessed a decided return toward normal between the Hawaiian Islands and the United States. Here the usual great anticyclone, which had disappeared by the close of January, began slowly to recover early in February, though it was not until the middle of the month that it occupied the greater part of its average area. In the Gulf of Alaska and over the entire Aleutian region the remarkable condition of very low pressures continued, though with a slow return toward normal by the last third of the month, this trend being more rapid north than south of the Aleutian chain itself. The center of the huge cyclonic area continued, as in January, to be at Dutch Harbor, where the departure from average was still considerable, being minus 0.42 inch. It is to be noted that the highest pressure readings at both Dutch Harbor and Kodiak still remained below 30 inches.

The following table gives data in this particular:

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level at indicated hours, North Pacific Ocean, February, 1926*

Station	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Dutch Harbor [1]	29.20	−0.42	29.84	23d [4]	28.26	1st.
St. Paul [1]	29.52	−.14	30.22	24th	28.74	2d.
Kodiak [1]	29.32	−.38	29.72	11th [4]	28.58	4th.
Midway Island [1]	29.98	−.05	30.26	9th [4]	29.68	6th.
Honolulu [2]	30.06	+.01	30.20	9th	29.83	6th.
Juneau [2]	29.59	−.33	30.09	27th	28.85	4th.
Tatoosh Island [2, 3]	29.90	−.08	30.54	25th	29.22	2d.
San Francisco [2, 3]	30.07	.00	30.35	24th	29.52	11th.
San Diego [2, 3]	30.06	+.02	30.33	4th	29.70	1st.

[1] P. m. observations only.
[2] A. m. and p. m. observations.
[3] Corrected to 24-hour mean.
[4] And other date.

Along the greater part of the coast of China high pressure prevailed, with only a few cyclones struggling through. Lows were moderately frequent and active over and to the east of Japan, and gales of considerable intensity accompanied the movements of some of them into the Pacific. The highest wind reported from this region occurred on the 5th, near 39° N., 147° E., where a storm of force 11 from the north was experienced by the Japanese steamship *Tokiwa Maru*, bound for Victoria. Moderate to whole gales occurred upon several other days, but they decreased in frequency over the whole western half of the ocean toward the end of the month.

Although as a whole the eastern HIGH attained nearly its normal development, yet two fierce storms raged over a considerable part of its usual area, and directly in the paths of steamships plying between Honolulu and the California ports. These violent disturbances were therefore experienced by a greater number of vessels than usually encounter individual storms over any part of the North Pacific. The earlier of the two was at its height on the 1st and 2d of the month. On these and the three or four following dates the lowest pressure readings of February occurred over most of the eastern part of the ocean. The principal LOW center on the 1st and 2d lay over the central Aleutians, but a secondary cyclone was developing to the southward on the 1st, and by the morning of the 2d lay near 38° N., 132° W., with whole gales to storm winds from westerly to southerly directions blowing over a wide area south of the new center on both dates. The secondary LOW moved northward off the coast, with rapidly falling pressure, but also decreasing energy, and on the 4th merged with the northern LOW which then lay across the northern part of the Gulf of Alaska.

Light to moderate winds henceforth prevailed over the scene of the earlier storm until the 10th, when a fresh cyclonic development occurred near 38° N., 140° W. This LOW moved slowly toward the California coast, until on the 11th and the morning of the 12th whole gales to hurricane winds swept much of the eastern half of the area traversed by the Honolulu–San Francisco steamers. After noon of the 12th the storm rapidly diminished, and in a day or two had lost its identity and become merely a part of the inactive lower extension of the Aleutian trough.

Along the northern steamer routes no reported gales exceeded 10 in force. These were met with on scattered dates mainly in the eastern and western regions, since over the upper central part of the ocean gales exceeding 8 in force were rare, though here lay the oscillating center of the permanent cyclonic formation.

From the Far East there is slight information at hand as to the existence of a depression, or typhoon, which apparently originated in the lower China Sea on the 4th. The cyclone seems to have moved northward, since there are reports of rough weather north and northeast of Luzon on the 5th and 6th. The American tanker *Meton*, leaving Manila on the 3d, bound for Los Angeles, reported a pressure reading of 29.02 inches on the 5th, in 19° 25′ N., 120° 30′ E., accompanied by squally weather and a maximum wind force of 8, ENE.

In the American Tropic there were several days with strong northeasterly gales reported, especially on the 20th and 27th in the Gulf of Tehuantepec, and on the 7th and 19th near 10° N., 85° W. The accompanying barometric depressions were slight. In the early meteorological history of the lower Central American coast and adjacent waters of the Pacific, frequent tornadoes were spoken of as occurring at night. While the name as then used probably applied to the more or less common severe local squalls of this region, yet there is now at hand a report—the first of the kind received in recent years—of a violent local whirl which was observed by the British steamer *Toco*, and thus briefly mentioned:

> At 2 a. m., L. M. T., February 4, in Lat. 6° 17′ N., 95° 25′ W., vessel passed under a low-lying Cu.-Nb. cloud and experienced a small whirlwind of hurricane force, lasting but a few minutes.

At Honolulu the weather was generally pleasant and somewhat warmer than usual for February, and only four days were colder than normal. The prevailing wind continued from the east, with a maximum velocity of 36 miles an hour from the NE. Precipitation was light, the total being only 0.44 inch, which is 3.31 inches less than the average. At Juneau the month was also warm, though precipitation was above the average. San Diego reported the second warmest February since the establishment of the station in 1871.

Fog was extraordinarily rare over the high seas this month, except off the coast of California, where it was reported on 10 days. Mention was made of the exceptional lack of fog in the Strait of Juan de Fuca. Well at sea in west longitudes widely scattered fog was observed on four days. In east longitudes the only mention of the phenomenon comes from a vessel which reported it on the 21st and 22d in the neighborhood of Shanghai.

MISCELLANEOUS PHENOMENA

Mirage off Farallon.—On the afternoon of February 26, 1926, when in vicinity of Piedras Blanco's Light and to north of it, a very noticeable mirage was in effect to the northwestward and inshore. Ships and shoreline were distended in various grotesque shapes, and visibility greatly increased. Heat waves could be seen plainly rising from the water; upper atmosphere exceptionally clear. When below Pigeon Point, the Farallon Islands Light showed above horizon as two distinct lights, one above the other, for an hour, then disappeared, and did not show again until within its limit of visibility. Distance seen 45 miles at pickup.—*Communicated by American S. S. "H. M. Storey," New York to San Pedro.*

Haze off Australian coast.—The haze observed on the 17th, 18th, and 19th of February was caused by the bush fires then raging over hundreds of miles of land in Australia. It was first observed when the Australian coast was over 900 miles distant, and became more dense as we approached the land. The haze was of a reddish color, and on the 19th it completely obliterated the horizon, and gave the sun the appearance of a red ball at noon.—*From report by British S. S. "Tahiti," Papeete to Sydney.*

DETAILS OF THE WEATHER IN THE UNITED STATES

GENERAL CONDITIONS

The weather of the current month was characterized by abnormally high temperature, especially in the Northwest and by temperature above normal elsewhere in the United States, except in New England—see Chart III of this REVIEW.

The warm weather was probably closely related to the atmospheric pressure distribution over the northeastern Pacific and contiguous land areas over which it was considerably below the normal.

Incursions of cold air from high latitudes were, therefore infrequent and of short duration.

Cyclonic storms passing over the Atlantic in the neighborhood of the Canadian Maritime Provinces had a tendency to greatly increase in intensity as in the previous month. The usual details follow.—*A. J. H.*

CYCLONES AND ANTICYCLONES

By W. P. DAY

Twenty low-pressure areas were plotted during the month, seven of which were of the so-called Alberta type. These Alberta storms, however, could generally be traced back across the Pacific Ocean to southeastern Asia. The remaining LOWS moved inland from the Pacific or originated over the South and Southwest. The latter type developed into important storms east of the Mississppi River.

The 15 HIGHS were about equally divided between the oceanic type moving inland from the Pacific and the continental type moving southward from Canada. None of these HIGHS, however, was important.

FREE-AIR SUMMARY

By V. E. JAKL

Free-air temperatures were above normal at all aerological stations, except due west, where they were about normal. (See Table 1.) The excess over normal increased in general from southern to northern stations, but was most pronounced in the northwest, as shown by Drexel and Ellendale. At those stations the departure was between 4 and 5 degrees above normal in about the first 1,000 meters altitude, but diminished thence upward until nearly normal temperatures were recorded above 3,000 meters. Over Broken Arrow, Groesbeck, and Royal Center the departure was about uniform with altitude and was greatest over Broken Arrow. The large excess over normal and its diminution with altitude in the upper levels over Drexel and Ellendale may be attributed to a less than usual frequency of cold waves over these stations, a characteristic of which, over northwestern sections, is to cause inverted lapse rates or at least an approximately isothermal state to considerable altitudes.

Relative humidities, as usually the case with temperatures above normal, were in general below normal. This departure was more especially evident in the upper levels, although departures at no station were pronounced enough to show any significant relation with other free-air conditions.

Free-air resultant winds were of about normal direction, being nearly west at all stations and at practically all altitudes. (See Table 2.) The general tendency, however, was for a slight north component, although over Ellendale the winds were quite decidedly northwest, except that in the lower levels where the positive temperature departure was greatest the winds were west-northwest, instead of the normal northwest direction. In the lower levels at a number of stations, particularly the more southerly, there was a slight south component.

It is significant of the rapid movement of HIGHS and LOWS, which continued from the previous month, that the free-air movement was stronger than normal, and that the resultants not only showed a general west direction, but that wind directions from day to day showed comparatively few exceptions to a west component for all stations and altitudes. Easterly winds in fact were almost entirely absent, only Key West showing pronounced east component to any considerable altitude, and that on only a few days. Resultant velocities were generally above normal throughout the vertical extent of observations at all stations. This was noticeably the case over Due West in the upper levels, where velocities were in excess of the normal as well as greater than those at any other station. Incidentally, Due West has in the upper levels the highest normal velocities for February of all the stations.

An example of some of the high velocities observed during the month is given by the records of the 25th, when the deep LOW centered over Chicago was effective in giving high velocities aloft to stations as remote from the center as Broken Arrow, Due West and Groesbeck, where winds from a general westerly direction ranging from 37 to 44 meters per second were recorded at various altitudes from 1,800 to 5,200 meters. This LOW had its effect on velocities aloft in the United States even after its center had passed east of Newfoundland on the 27th, as shown by observations on that date at Broken Arrow, Drexel, Due West, Ellendale, Madison, and Royal Center. The maximum free-air velocities recorded at these stations are approximately indicated by those reported from the extreme stations, Due West and Ellendale, which ranged from 53 meters per second from the west-northwest at 6,500 meters, to 31 meters per second from the northwest at 4,000 meters, respectively.

The occasional extreme stratification of the air attending inversions in the lower levels, characteristic of the northern stations in the winter season, was shown at Ellendale several times during the month by the occurrence of a mirage or looming phenomenon. A description of the more pronounced one occurring on the morning of the 13th is given in the following extract from the report from that station:

Low-lying dense fog occurred with Ci. St. and A. St. clouds at 7:30 a. m. The surface wind was almost calm and it was necessary to carry out the head kite 600 meters in order to launch it into a sufficiently strong wind aloft to support it. The land slopes downward about 10 meters in the distance of 600 meters to which the kite was carried, and the kite instrument record shows that at this distant point the temperature was about 5° lower than at the reel house, where the temperature was −4.5°. The record further shows that immediately the kite was launched, the temperature rose rapidly the first few hundred meters. A little later when the dense fog had thinned to light fog an interesting mirage was observed. A grove of trees about 2,700 meters east of the reel house was visible at the top of the fog, probably about three times their height above the ground. The trees could not be seen through the fog on the ground but the upper third of their height was seen ranging along the top of the fog layer. Another solitary tree about three miles southeast of the station was also observed in the same manner. This is the first time that relatively close objects have been observed in mirage; on other occasions distant objects only have been observed in connection with a low-lying smoke layer.

The free-air conditions on this date are shown in the following table:

Altitude, m. s. l.	Temperature	Relative humidity	Wind Direction	Wind Velocity
Meters	° *C.*	*Per cent*		*M. p. s.*
Surface (444)	−4.5	98	NW	0.9
819	−0.1	82	NW	8.5
1,744	−6.0	75	NW	13.7
1,870	−4.6	53	NW	13.4
2,750	−9.9	29	NW	9.9
3,100	−12.9	36	WNW	14.4

This record, while not showing as pronounced a temperature inversion as is often observed, nevertheless indicated a sharp stratification. This may be inferred from the circumstance of rapid change in wind from nearly calm at the surface to strong wind in the first few hundred meters; also from the temperature change in a difference of ten meters altitude mentioned in the description.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during February, 1926*

TEMPERATURE (° C.)

Altitude m. s. l.	Broken Arrow, Okla. (233 meters) Mean	Departure from 8-yr. mean	Drexel, Nebr. (396 meters) Mean	Departure from 11-yr. mean	Due West, S. C. (217 meters) Mean	Departure from 5-yr. mean	Ellendale, N. Dak. (444 meters) Mean	Departure from 9-yr. mean	Groesbeck, Tex. (141 meters) Mean	Departure from 8-yr. mean	Royal Center, Ind (225 meters) Mean	Departure from 8-yr. mean
Meters												
Surface	6.1	+0.9	0.7	+4.2	8.5	0.0	−5.2	+4.3	11.1	+0.7	−0.8	−0.8
250	6.1	+1.0			8.4	+0.1			10.9	+0.8	−1.0	+0.8
500	5.8	+1.8	0.7	+4.5	7.3	+0.3	−5.3	+4.2	10.6	+1.4	−2.8	+0.8
750	5.6	+2.4	0.8	+4.8	6.1	+0.1	−4.8	+4.3	10.3	+1.4	−3.4	+0.9
1,000	5.9	+2.9	1.0	+4.4	5.1	−0.1	−3.9	+4.5	10.0	+1.3	−3.2	+1.3
1,250	5.4	+2.7	0.6	+3.5	4.3	0.0	−3.3	+4.6	9.4	+1.3	−3.2	+1.8
1,500	4.4	+2.4	0.3	+3.3	3.3	−0.1	−3.4	+4.4	8.8	+1.4	−3.6	+1.8
2,000	2.7	+2.2	−2.2	+2.1	1.1	−0.5	−5.8	+3.3	6.5	+1.1	−5.2	+1.4
2,500	0.3	+2.2	−5.1	+1.4	−1.0	−0.2	−9.0	+2.3	3.9	+0.8	−7.6	+0.8
3,000	−2.1	+2.4	−8.2	+0.9	−2.8	+0.1	−11.7	+2.2	1.1	+0.4	−9.9	+0.9
3,500	−4.5	+2.5	−11.3	+0.5	−4.6	+0.9	−14.3	+2.3	−1.6	+0.2	−12.4	+1.1
4,000	−7.5	+2.2			−8.0	+0.6	−18.1	+1.1	−4.4	−0.1	−15.7	+1.0
4,500	−10.3	+2.4							−6.6	+0.1		
5,000	−12.6	+2.8							−8.1	+1.5		

RELATIVE HUMIDITY (%)

Altitude m. s. l.	Broken Arrow Mean	Departure	Drexel Mean	Departure	Due West Mean	Departure	Ellendale Mean	Departure	Groesbeck Mean	Departure	Royal Center Mean	Departure
Surface	68	0	76	−1	67	0	82	0	68	−5	78	0
250	68	0			67	0			65	−6	78	0
500	63	−2	72	−3	64	0	81	0	59	−8	79	+1
750	57	−4	65	−5	60	−2	75	0	53	−10	78	+3
1,000	47	−9	59	−5	56	−4	68	−2	46	−12	71	+1
1,250	43	−9	55	−5	53	−6	62	−4	41	−14	64	−2
1,500	41	−9	49	−8	52	−6	58	−4	35	−16	60	−2
2,000	32	−13	46	−7	51	−5	53	−6	32	−14	56	−1
2,500	29	−14	46	−6	50	−5	50	−9	32	−11	57	+1
3,000	29	−12	45	−7	40	−10	46	−12	35	−7	58	+1
3,500	27	−13	49	−3	18	−27	43	−13	37	−3	56	−2
4,000	27	−13			22	−29	49	−6	36	−1	56	−4
4,500	27	−13							42	+11		
5,000	27	−13							57	+26		

VAPOR PRESSURE (mb.)

Altitude m. s. l.	Broken Arrow Mean	Departure	Drexel Mean	Departure	Due West Mean	Departure	Ellendale Mean	Departure	Groesbeck Mean	Departure	Royal Center Mean	Departure
Surface	6.60	+0.39	4.89	+0.98	7.64	−0.36	3.43	+0.77	9.27	−0.87	4.54	+0.08
250	6.54	+0.38			7.53	−0.35			8.90	−0.29	4.48	+0.09
500	5.65	+0.24	4.59	+0.88	6.74	−0.30	3.35	+0.74	7.98	−0.27	3.97	+0.10
750	4.87	+0.11	4.04	+0.69	5.87	−0.60	3.15	+0.71	6.93	−0.56	3.69	+0.16
1,000	4.16	−0.08	3.64	+0.50	5.04	−0.98	2.95	+0.58	5.90	−0.78	3.42	+0.19
1,250	3.61	−0.20	3.28	+0.30	4.48	−1.04	2.79	+0.50	4.98	−0.98	3.22	+0.33
1,500	3.26	−0.19	2.96	+0.20	4.05	−0.99	2.61	+0.47	4.06	−1.09	2.93	+0.35
2,000	2.38	−0.34	2.36	+0.05	3.30	−0.78	1.97	+0.19	3.24	−0.74	2.40	+0.32
2,500	1.96	−0.30	1.94	+0.02	2.66	−0.65	1.45	+0.01	2.58	−0.63	2.06	+0.34
3,000	1.70	−0.14	1.56	−0.02	1.74	−0.82	1.09	−0.04	2.20	−0.52	1.76	+0.35
3,500	1.43	−0.08	1.33	+0.06	0.39	−1.58	0.81	−0.04	1.82	−0.43	1.57	+0.48
4,000	1.22	−0.02			0.17	−1.58	0.62	−0.05	1.36	−0.42	1.47	+0.62
4,500	1.12	+0.09							1.13	−0.06		
5,000	0.66	−0.05							1.20	+0.26		

TABLE 2.—*Free-air resultant winds (m. p. s.) during February, 1926*

Altitude m. s. l. (meters)	Broken Arrow, Okla. (233 meters) Mean Dir.	Vel.	8-year mean Dir.	Vel.	Drexel, Nebr. (396 meters) Mean Dir.	Vel.	11-year mean Dir.	Vel.	Due West, S. C. (217 meters) Mean Dir.	Vel.	5-year mean Dir.	Vel.
Meters												
Surface	S. 81°W.	1.1	N.31°W.	0.6	S. 72°W.	2.5	N.73°W.	1.4	S. 78°W.	4.0	S. 84°W.	2.0
250	S. 79°W.	1.1	N.37°W.	0.5					S. 78°W.	4.5	S. 85°W.	2.2
500	S. 55°W.	2.2	S. 73°W.	0.7	S. 77°W.	4.9	N.79°W.	2.2	S. 78°W.	8.0	S. 84°W.	3.9
750	S. 62°W.	3.5	S. 63°W.	1.8	S. 86°W.	7.4	N.75°W.	4.2	S. 79°W.	9.7	S. 80°W.	5.5
1,000	S. 76°W.	3.8	S. 72°W.	2.6	N.82°W.	9.4	N.68°W.	5.5	S. 88°W.	11.3	S. 82°W.	6.5
1,250	N.81°W.	5.2	N.87°W.	3.7	N.76°W.	9.6	N.67°W.	6.8	N.89°W.	12.3	S. 84°W.	7.9
1,500	N.88°W.	6.5	N.84°W.	4.6	N.72°W.	11.2	N.66°W.	8.4	N.88°W.	13.7	S. 86°W.	9.8
2,000	N.82°W.	8.7	N.78°W.	6.9	N.71°W.	12.6	N.68°W.	10.6	N.83°W.	16.4	S. 89°W.	12.9
2,500	N.78°W.	9.6	N.77°W.	7.8	N.73°W.	15.1	N.70°W.	13.0	N.81°W.	17.9	S. 88°W.	14.4
3,000	N.76°W.	10.2	N.78°W.	9.8	N.71°W.	16.2	N.74°W.	14.6	S. 89°W.	19.9	S. 86°W.	16.4
3,500	N.70°W.	12.4	N.67°W.	11.1	N.70°W.	20.6	N.74°W.	16.2	S. 82°W.	21.4	N.87°W.	17.3
4,000	N.75°W.	13.8	N.72°W.	11.7	N.54°W.	24.8	N.78°W.	16.4	S. 83°W.	21.7	S. 89°W.	15.2
4,500	N.85°W.	13.5	N.71°W.	12.3					N.78°W.	23.2	N.87°W.	17.8
5,000	N.82°W.	13.8	S. 87°W.	12.6								

Altitude m. s. l. (meters)	Ellendale, N. Dak. (444 meters) Mean Dir.	Vel.	9-year mean Dir.	Vel.	Groesbeck, Tex. (141 meters) Mean Dir.	Vel.	8-year mean Dir.	Vel.	Royal Center, Ind. (225 meters) Mean Dir.	Vel.	8-year mean Dir.	Vel.
Meters												
Surface	N.63°W.	1.3	N.45°W.	3.2	S. 63°W.	2.0	S. 80°W.	0.6	N.88°W.	2.3	S. 81°W.	2.0
250					S. 62°W.	2.8	S. 69°W.	0.9	N.88°W.	2.5	S. 80°W.	2.2
500	N.82°W.	1.8	N.48°W.	3.5	S. 60°W.	4.7	S. 47°W.	1.8	S. 78°W.	4.4	S. 69°W.	3.9
750	N.78°W.	4.2	N.57°W.	4.6	S. 63°W.	5.5	S. 53°W.	2.5	S. 78°W.	6.3	S. 69°W.	5.6
1,000	N.66°W.	5.3	N.55°W.	5.3	S. 65°W.	6.4	S. 64°W.	3.7	N.88°W.	8.0	S. 76°W.	6.9
1,250	N.61°W.	6.4	N.56°W.	6.3	S. 73°W.	7.8	S. 73°W.	4.8	N.82°W.	8.0	S. 83°W.	7.9
1,500	N.57°W.	7.5	N.58°W.	7.4	S. 75°W.	8.4	S. 78°W.	6.2	N.74°W.	8.4	S. 88°W.	9.2
2,000	N.60°W.	9.7	N.62°W.	9.6	N.82°W.	9.6	S. 87°W.	7.6	N.66°W.	10.6	N.87°W.	11.1
2,500	N.60°W.	12.2	N.63°W.	11.8	N.87°W.	10.4	S. 88°W.	8.7	N.66°W.	11.2	N.86°W.	13.2
3,000	N.62°W.	13.6	N.66°W.	13.1	N.74°W.	13.2	S. 88°W.	10.6	N.74°W.	12.1	N.88°W.	14.2
3,500	N.63°W.	14.9	N.68°W.	13.2	N.84°W.	11.7	N.88°W.	11.2	N.78°W.	12.0	N.86°W.	16.1
4,000	N.65°W.	17.2	N.66°W.	14.2	N.78°W.	11.9	N.88°W.	12.2	S. 74°W.	7.8	S. 87°W.	14.5
4,500	N.68°W.	16.0	N.66°W.	15.4	S. 83°W.	14.3	N.82°W.	12.9	S. 45°W.	22.0	S. 77°W.	17.2
5,000					S. 67°W.	13.1	N.62°W.	9.6				

TABLE 3.—*Mean free-air temperatures, relative humidities and vapor pressures; and resultant winds during February, 1926, at Washington, D. C.*

Altitude m. s. l.	Naval Air Station, D. C. (7 meters)			Weather Bureau (34 meters)	
				Wind	
	Temperature	Relative humidity	Vapor pressure	Direction	Velocity
Meters	*° C.*	*Per cent*	*Mb.*		*M. p. s.*
Surface	0.3	78	4.99	N. 50° W	1.7
250	0.1	74	4.68	N. 67° W	4.4
500	−0.1	70	4.30	N. 65° W	6.9
750	−1.1	69	3.94	N. 62° W	8.8
1,000	−2.2	69	3.63	N. 67° W	9.3
1,250	−3.4	70	3.38		
1,500	−4.0	68	3.14	N. 56° W	13.2
2,000	−4.7	63	2.67	N. 61° W	16.3
2,500	−6.4	58	2.17	N. 57° W	18.2
3,000	−8.9	54	1.65	N. 55° W	19.2
3,500	−12.2	54	1.31	N. 47° W	17.0
4,000	−15.9	53	0.92	N. 68° W	17.0
4,500	−19.3	54	0.53	N. 45° W	16.0

THE WEATHER ELEMENTS

By P. C. DAY, In Charge of Division

PRESSURE AND WINDS

The distribution of the atmospheric pressure resembled that of the preceding month, moderately high pressure over the Plateau region, diminishing eastward, with distinctly low pressure, on the average, over the North Atlantic coast and the Canadian Maritime Provinces.

Only a few of the cyclones developed into important storms over the interior districts, but a number increased markedly in proportion as they approached the Atlantic coast, several becoming storms of great severity over the southern New England coast, attended by unusually low barometric pressure and winds of gale force.

One of the most important of these had its origin near the coast of northern California, where it appeared on the morning of January 31, whence it progressed southeasterly to the Texas coast by the morning of the 3d. From that point it moved rapidly northeastward to southern New England by the morning of the 4th with greatly increasing intensity and rapidly falling pressure, and during the following 24 hours continued its northeastward course toward the Grand Banks with pressure only slightly above 28.5 inches.

A second storm, of much shorter path but developing great severity, moved from the Carolina coast to southern New England on the 9th and 10th and thence northeastward with barometric pressure only slightly above 29.0 inches.

A third storm, pursuing a course similar to that at the first of the month, advanced southeastward from the Oregon coast and was central over southwestern Missouri on the morning of the 18th, whence it moved northeastward to southern New England during the following 24 hours as a storm of wide extent and general precipitation over the eastern third of the country. This storm continued its northeasterly course with increasing intensity, the pressure falling below 29 inches on the morning of the 20th.

The only important storm over the Great Lakes had its origin in the Southwest and was central over northern Texas on the morning of the 24th, whence it moved to southern Lake Michigan by the following morning, increasing greatly in intensity, the barometer falling below 29 inches at the center. This storm moved to the Canadian Maritime Provinces during the following 24 hours, and was attended by moderate to heavy precipitation from the Great Plains eastward, with snow over northern districts and high winds over portions of the Great Lakes and near-by areas.

Important anticyclones were notably absent during the month, but several of moderate strength finally reached the southern States attended by sharp changes in temperature.

The average pressure for the month was mainly lower than normal, except over the Southwest. From the upper Missouri Valley and the Canadian Northwest Provinces eastward and southeastward to the Atlantic coast the average pressure was from 0.10 to 0.25 inch below normal, a few stations in New England reporting the lowest average pressure of record for February.

Over all parts of the country, save for a small area near Lake Superior, the averages of pressure were lower than those for January, the deficiencies being comparatively large over the far Northwest and along the middle Atlantic coast.

On account of the persistence of low pressure over eastern districts the prevailing winds had a distinct westerly or northwesterly trend from the Missouri Valley eastward and southeastward to the Atlantic coast, becoming more northerly in portions of the Great Lakes region and New England.

Over the southern plains the winds were mainly from southerly points, and similar directions prevailed in the far Northwest.

High winds prevailed over the Pacific coast districts for several days near the beginning of the month and they were high along the Atlantic coast on the 3d and 4th, 10th and 11th, and 19th and 20th. From the 24th to 26th high winds prevailed over much of the Ohio and lower Mississippi Valleys and the southern portions of the lower Lake region and thence to New England. A table at the end of this section gives details of the more important local storms.

TEMPERATURE

The marked feature of the weather was the unusual warmth that prevailed over the greater part of the country, and particularly its uniformity over the central and western districts, a condition that likewise prevailed over large portions of the same territory during the two preceding months. At a number of points in the area from the upper Mississippi Valley westward to the Pacific the daily temperatures were normal or above on every day of the month, and over the greater part of this area there were not more than one or two days with temperature below normal. Not only were the temperatures far above normal, but at some of the most northerly points, the temperature did not fall below zero. At Havre Mont., usually one of the coldest stations in the country, the lowest temperature was 6° above zero, a record not observed in any previous February.

At many points in the Missouri Valley and thence west to the Pacific the average temperature was the highest of record for February, and in a number of instances the combined average of the three winter months shows the winter of 1925–26 as the warmest of record.

In the Canadian districts adjacent to Montana and North Dakota the monthly means were likewise as high as those previously referred to, but high temperatures probably did not extend northward as far as in January. At Eagle, Alaska, where the January average was nearly 30° above normal that for February was apparently less than 1° above, due mainly to marked cold during the

latter part of the month, which had not become effective over districts to the southward at the close.

Over a small area from the lower Lakes eastward and northeastward to the Atlantic coast, and the more eastern Canadian Maritime Provinces the average temperature was mainly lower than normal, and the Florida peninsula was likewise colder than normal, though no marked cold occurred at any time.

The dates of the highest and lowest temperatures for the several sections were not uniform over extensive areas, though in the Gulf States the highest temperatures were mainly about the 14th to 16th; in the Ohio Valley and Middle Atlantic States about the 21st to 25th; and from the 26th to 28th in the Northwest and far West.

The lowest temperatures occurred mainly during the first two decades, about the 1st and 2d in the northern plains; 6th to 9th along the North Atlantic coast; 11th to 12th in the Ohio Valley and Gulf States, and generally from the 14th to 20th in the Rocky Mountain and Plateau States.

PRECIPITATION

For the country as a whole precipitation was deficient, though the areas of material lack in the usual fall were not large, and confined mainly to Texas and the adjacent portions of the lower Mississippi Valley, and locally in the Ohio Valley, Florida, and the far Southwest. A small area in the southern portions of Alabama and Georgia had precipitation above normal, and in the Appalachin region from the Virginias to New England there was usually a moderate excess; also in the Lake region, lower Missouri Valley, and the Pacific Coast States. In California, where both rain and snow had been greatly deficient during the preceding months of the winter, the February precipitation was mainly above normal, materially so in some central and northern districts; in portions of the southeastern part of the State, however, there was a deficiency. Over the more important areas of the State the precipitation was generous, greatly relieving the existing water shortage and improving the outlook for the coming summer.

SNOWFALL

The general deficiency in precipitation over the Northwest and in the western mountain districts was due mainly to a lack of the usual snowfall, and even in the Pacific Coast States where there was some excess of precipitation it was mainly due to rains in areas where snow usually falls at this period of the winter.

From the Great Lakes eastward there was a very general excess in the total falls, and in portions of New England the totals were among the heaviest of record for February.

The heaviest falls over eastern districts occurred generally on the 3d to 5th and 9th to 10th when, from the Potomac drainage area to New England, the amounts ranged up to 20 inches. High winds during and after these storms caused much drifting and interference with traffic over the more northern districts.

Some heavy snows occurred in the Rocky Mountain region and locally to the eastward on the 16th to 18th, amounts up to 18 inches being reported locally in northeastern and central Kansas; and heavy snow in portions of Utah was attended by many snow slides; one at Bingham caused the death of 36 persons, injured many others, damaged or destroyed a number of buildings, and interfered with traffic.

In the western mountains snowfall was mainly less than normal, except in California, where in the Sierra Nevada it was mainly above normal, though, due to deficient falls in the earlier months of the winter, the accumulated depths on ground at the end of the month were mainly less than normal, and on account of unseasonably high temperatures, it was melting rapidly at the lower elevations.

In other portions of the western mountains the total depth of snow on ground at the end of the month was mainly deficient, except locally on the eastern slopes of the Rockies.

On account of the deficient snowfall and the very general excess of temperature during the winter, causing early melting at the lower levels, the outlook for a plentiful supply of water for irrigation and power purposes is generally unfavorable in the areas where water is most needed.

RELATIVE HUMIDITY

Like precipitation, the relative humidity was mainly higher than normal in the Lake region and thence eastward, also in portions of the Missouri and upper Mississippi Valleys, and locally in California and Oregon. Elsewhere the relative humidity was deficient as a rule, and to a marked extent from Texas and the lower Mississippi Valley westward and northwestward to the Plateau region.

SEVERE LOCAL HAIL AND WIND STORMS, FEBRUARY, 1926

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
California Coast	(1)					High winds and gales.	Shipping imperiled; considerable damage to piers and coast resorts.	Official, U. S. Weather Bureau.
New Orleans, La., and vicinity.	2	10:30 a. m.			$13,000	Tornadic wind	One house practically wrecked; roofs and fences damaged; wire service impaired.	Do.
West Palm Beach, Fla., and vicinity.	3	6:30 a. m.		1	35,000	..do	Three hundred persons made homeless; trucks and touring cars wrecked; wires and trees prostrated; many persons injured.	Official, U. S. Weather Bureau Journal (Jacksonville, Fla.).
Meadow Point, Puget Sound, Wash.	3	A. m.			18,000	High wind	Deck load of barge lost	Official, U. S. Weather Bureau.
Cecil, Kent, and Talbot Counties, Md.	3				5,000	..do	Telephone and light service crippled	Do.
Hartford, Conn.	3-4					Wind and snow	General delay of interurban traffic; factory roof collapsed causing loss of several lives and much property damage.	Do.
Walla Walla, Wash., and vicinity.	3-6				2,150	Wind and rain	Power lines damaged by wind; much property damage by flooding.	Do.
North Head, Wash.	4					High wind	Trees uprooted; all land wire communication between Astoria, Oreg., and South Bend and Raymond, Wash., disrupted.	Do.
Lower Hudson Valley and Long Island, N. Y.	10					Snow and high wind.	Railway service, motor, and street car traffic seriously delayed.	Do.
New Burnside, Ill.	13					Wind	Minor property damage reported	Do.
Cairo, Ill.	13-14					Thunderstorm and wind.	Communication lines, signs, awnings, and trees blown down; traffic in some sections discontinued for some time.	Do.
Grayson, Hart, and Barren Counties, Ky.	14				12,000	Electrical	Several barns destroyed	Do.
Lexington, Ky. (near)	14				100,000	..do	Stock barn destroyed, causing loss of 25 horses	Do.
Raleigh, N. C., and vicinity	14	5:50 p. m.				Heavy hail	No damage reported	Do.
Bingham, Utah (near)	17	A. m.		36		Snowslide	Fourteen miners' cottages and a three-story frame boarding house demolished; 13 persons injured.	Do.
North-central and northeastern counties, Kansas.	17-18			1	10,000	Wind, snow, and sleet.	All traffic and electric service demoralized for about 24 hours; telephone, telegraph, and power lines broken.	Do.
Calhoun and Cherokee Counties, Ala.	18	6:15 p. m.			2,000	Hail	Some damage to timber and houses near Wellington; slight damage in Cherokee County.	Do.
Terre Haute, Ind.	18	6:28 p. m.			400	Thunderstorm	Poles blown down interfering with street car service for several hours.	Do.
Arkansas	24	P. m.				Straight winds	Damage throughout State not estimated	Do.
Lake Village, Ark. (6 mi. south of), to near Greenville, Miss.	24	8 p. m.	100	7	70,000	Tornado	Twenty-seven persons injured; damage in Mississippi not estimated.	Do.
Near boundary of Leflore and Holmes Counties, Miss.	24	P. m.		2		Probably tornado	Property damage not reported	Do.
Teasdale, Miss.	24	P. m.		1		Probably tornado	Practically whole town demolished; 24 injured	Do.
Vicksburg, Miss.	24	10:56 p. m.				Wind	Minor property damage reported	Do.
New Madrid County, Mo. (parts of).	24	P. m.			500	High wind	Several silos wrecked; small tenant houses damaged and a few trees uprooted.	Do.
Nashville, Tenn.	24	P. m.				..do	Telephone lines down; plate glass windows broken.	Do.
Indiana, Illinois, and Ohio (parts of).	24-25					High wind and rain.	Considerable damage to property; public utilities suffer heavy losses; wind became tornadic in places.	Official, U. S. Weather Bureau; Journal (Evansville, Ind.); Plain Dealer (Dayton, O.).
Memphis, Tenn.	24-25					Wind and rain	Trees and wires damaged: streets flooded	Official, U. S. Weather Bureau.
Baltimore Harbor, Md.	25					High winds	Slight damage to two lighters and several other vessels.	Do.
Meridian, Miss.	25	1:30 a. m.				Wind squall	Minor property damage reported	Do.
Southwestern counties, Pennsylvania.	25	P. m.				Violent wind and rain.	Windows shattered; chimneys, roofs and other structures damaged in Uniontown, Pittsburgh, and Greensburg districts. Poles blown down; lighting circuits out of commission.	Do.
Buffalo, N. Y., and vicinity	26					High wind and snow.	Traffic considerably impeded by drifting snow	Do.
Bismarck, N. Dak.	28	P. m.			500-1,000	Wind	Roof blown from brick kiln	Do.

[1] Continued from January 5.

STORMS AND WEATHER WARNINGS

WASHINGTON FORECAST DISTRICT

Storm warnings that were displayed on January 31 from Delaware Breakwater northward in connection with a disturbance that developed over the southeastern Gulf of Mexico and moved almost due north, were continued on February 1. Another disturbance moved rapidly southeastward from the northern California coast to the Texas coast and from there it advanced rather slowly northeastward with increasing intensity to Newfoundland, which it reached during the 5th. Storm warnings were ordered from Jacksonville, Fla., to Cape Hatteras at 10 p. m., of the 2d, north of Cape Hatteras to Boston the morning of the 3d, and north of Boston to Eastport, Me., at 3 p. m., of the same date. Both Atlantic City, N. J., and Nantucket, Mass., reported a wind velocity of 68 miles an hour from the northeast on the 4th.

The next disturbance of importance advanced southeastward from British Columbia to the upper Ohio Valley during the 7th–9th. The evening reports of the 9th showed that a secondary was developing over Virginia and North Carolina. It seemed certain that this secondary disturbance would increase in intensity as it moved northeastward and would soon become the main disturbance. Accordingly northeast storm warnings were ordered displayed at 9.30 p. m. from Sandy Hook, N. J., to Eastport, Me. All stations in this area reported verifying wind velocities, the highest being 68 at Nantucket, Mass., and 64 at Block Island, R. I., both from the northeast.

A disturbance that moved rapidly eastward from Nevada to the Middle Atlantic and North Atlantic States

during the 12th–14th increased gradually in intensity, New York City reporting a barometer reading of 29.26 inches at 8 p. m. of the 14th. Storm warnings were displayed at 10 a. m. of the 14th from Jacksonville, Fla., to Eastport, Me. However, the only station that reported a verifying velocity was Eastport, where the maximum was 38 miles an hour from the northeast.

A disturbance that entered the United States on the Washington and Oregon coasts was central over extreme southern Illinois at 8 p. m. of the 18th. The pressure-change chart indicated that this disturbance would increase considerably in intensity, but that strong winds along the Atlantic coast were not likely to occur until after the passage of the center of the trough of low pressure. An advisory warning to this effect was sent to all Weather Bureau stations on the Atlantic coast at 9 p. m. of the 18th, and at 10 a. m. of the 19th northwest storm warnings were displayed from Jacksonville, Fla., to Eastport, Me. Several stations reported a maximum wind velocity of 40 miles or more an hour, the highest being 60 from the northwest at New York City.

Again on the evening of the 24th a disturbance that was central over Arkansas showed unmistakable evidence of a marked increase in intensity, as it advanced northeast, and an advisory warning was sent to all stations on the Atlantic and east Gulf coasts. The following morning southeast storm warnings were displayed from Eastport, Me., to Delaware Breakwater, and southwest warnings southward to Cape Hatteras. The following high wind velocities were reported: New York City, 76 m. p. h., and Atlantic City, 68 m. p. h., both from the south; and Nantucket, Mass., and Norfolk, Va., 56 and 52 m. p. h., respectively, from the southeast.

Small-craft warnings were issued for portions of the Atlantic coast on the 10th, 19th, 25th, and 26th, and for the east Gulf coast on the 19th. Warnings of strong northerly winds for the Panama Canal Zone were issued on the 19th and the 26th.

Heavy-snow warnings were issued on the 3d for portions of New England, New York, Pennsylvania, and New Jersey, and they were fully verified. On the morning of the 4th the following depths of snow were reported: Binghamton, 17 inches; Boston, 15; and Albany and Harrisburg, 12.

Frost warnings were included in the regular a. m. forecasts on 14 dates for portions of the extreme south, and on the 11th and 19th frost was predicted for southern Florida as far south as Miami.—*C. L. Mitchell.*

CHICAGO FORECAST DISTRICT

The month was comparatively uneventful, so far as the occurrence of inclement weather conditions is concerned. In fact, the weather was remarkably mild in the western portion of the district, and even in the eastern portion the temperature averaged well above normal at most stations. As might be expected, therefore, cold waves were infrequent, and those that did occur affected more or less limited areas only in the Lake region and adjacent territory. Similarly, the few cold wave warnings issued included in their scope in each instance relatively small areas. The dates on which warnings were issued were the 13th to the 17th, inclusive. For the most part the issuance of the warnings was justified. In most of the cases where cold waves occurred without warning the forecats had called for "colder" or "much colder."

Storms on Lake Michigan.—Only one disturbance of major proportions affected Lake Michigan. This did not attain storm intensity in its eastward movement until it had almost reached the Lake. The storm resulted from the coalescing of two disturbances, one from the northwest and the other from the southwest, on the night of the 24th–25th. At the morning observation on the 25th the reduced barometer at Grand Haven, Mich., was 28.86 inches. North and northwest gales prevailed over the entire Lake on that date, attended by heavy rain, sleet, or snow. The warning for this storm was issued on the night of the 24th. Other warnings of this character for shipping on the Lake were issued on the 5th, 8th, 11th, 18th, and 28th.—*C. A. Donnel.*

NEW ORLEANS FORECAST DISTRICT

The weather in this district was exceptionally mild and dry, averaging much like the weather of February, 1925.

Northwest storm warnings were issued for the Texas coast on the 17th, at 8:30 p. m., because of a disturbance that was moving eastward from the southern Rocky Mountain slope, followed by strong northwest winds, which extended to the coast during the 18th, gales continuing at Galveston into the morning of the 19th.

Local, southeast gales of brief duration occurred at Corpus Christi, Tex., on the 21st, for which small craft warnings had been displayed by the official in charge at Corpus Christi. The maximum wind velocity, 44 miles from the southeast, was out of proportion to the moderate barometric gradient.

Small-craft warnings were displayed on the Louisiana coast on the 19th and on the Texas coast on the 26th; and a "norther" warning for Tampico, Mexico, was issued on the 26th. These warnings were justified.

Timely warnings were issued on the 14th and 17th, respectively, for moderate cold waves in Oklahoma and extreme northwestern Arkansas and were justified. Cold wave warnings for the northern portion of east Texas, also, were issued on the 17th; but the movement of the area of high pressure was not attended by temperatures low enough to cause a cold wave so far south.

Frost or freezing temperature warnings for portions of the more southern part of the district were issued on the 1st, 10th, 18th, 19th, 26th, and 27th. Conditions occurred as forecast except for the warning issued on the 1st.—*R. A. Dyke.*

DENVER FORECAST DISTRICT

With low barometric pressure prevailing most of the time along the Pacific coast and over the Canadian Northwest, the month was remarkably mild throughout the district. Several disturbances from the Pacific entered or crossed the district, causing more stormy weather than usual in northern Utah, which was about the only part of the district in which precipitation was not deficient. The only cold-wave warning issued was on the evening of the 13th for the extreme eastern portions of Montana and Wyoming. The temperature fall the following morning was from 12° to 24°, with a minimum of zero at Williston, N. D. No other cold waves occurred. Frost warnings were issued on the 4th and 17th for southwestern Arizona, and on the 23d for southern Arizona; the last two were followed by temperatures low enough for the formation of frost in the regions specified.—*E. B. Gittings.*

SAN FRANCISCO FORECAST DISTRICT

Pacific States Forecast District.—February opened with the entire northeastern Pacific Ocean dominated by the Aleutian low pressure system, which was pivoted near the Island of Unalaska with major axis swinging between a south and a southeastward inclination. On the first day of the month this axis was pointing toward the southeast, a characteristic position for the propagation of disturbed conditions along and near the lower Pacific coast. Two LOWS had already developed within the southeastern extension of this system and passed inland over California during the closing days of January, and a third one appeared in the same general area on the evening of February 2. It was evident that it would be the most severe of the three, and southeast storm warnings were displayed along the northern California coast that evening, and extended the following day to cover the entire coast from the Straits of Juan de Fuca to San Diego. Very high velocities followed, gales of from 72 miles per hour at Point Arguello to 80 at Point Reyes and 72 at the mouth of the Columbia River being recorded during the ensuing day and night. The storm center moved northward on the 3d, and warnings were allowed to expire on the southern California coast but were continued at all stations from Point Reyes northward. Strong winds prevailed over this section with gales on the Oregon-Washington coast on the 3d and 4th.

All warnings were allowed to expire on the California coast on the evening of the 4th, but were raised again the following afternoon from Mendocino to Eureka, and continued at other points to the northward, due to the development of a new disturbance in the low pressure system over the ocean. This storm passed inland over British Columbia during the following night, attended by gales on the coasts of Oregon and Washington. The following day warnings at all points were taken down, after having been displayed continuously on the Oregon-Washington coast for 90 hours.

A high-pressure phase followed but was of brief duration. The barometer began to fall soon afterward in the Gulf of Alaska, and on the evening of the 8th southwest warnings were displayed on the Washington coast and extended the morning after to cover the Oregon coast. Gales followed on the 9th.

On the latter date a marked change took place in oceanic pressure distribution. The barometer, which for a considerable period had been low over all that part of the middle Pacific Ocean which was under observation began to rise, and on the 10th a high pressure area was charted which extended from the western Aleutian Islands south and southeastward to tropical latitudes. An acceleration in the rate of storm movement to the eastward was to be expected, and a disturbance noted on the morning of the 10th centered in approximately latitude 45° N., and longitude 150° W., appeared 24 hours later in latitude 40° N., and longitude 128° W., calling for warnings all along the California coast. The rising pressure in the rear of this disturbance, however, did not prove to be continuous, and on the 12th a general fall was observable over the ocean beyond the 150th meridian. This was reflected in retarded movement of the storm off the California coast. It failed to progress inland but remained nearly stationary, its center only a short distance west of Cape Mendocino. Stormy weather with strong southerly winds and gales consequently prevailed along the central and southern coasts of California until the 13th, when the disturbance began to dissipate and all warnings were lowered.

On the night of the 16th a new disturbance developed in the Gulf of Alaska and warnings were displayed the following morning along the Oregon-Washington coast, and on the northern California coast a day later. Gales followed the display of these warnings on the 18th and 19th, subsiding on the 19th.

The general pressure situation changed radically on the 20th. A large high pressure area occupied the ocean between California and the Hawaiian Islands, and began to push in upon the California coast. It marked a cessation of general rains in that State, and except for light amounts in the extreme north portion no further precipitation occurred in California during February. Unsettled weather continued in the North Pacific States, however, due to the slow advance of the HIGH and the generation of vortices on its northern periphery. Two of these passed successively on the 21st and 23d from the upper Gulf of Alaska along the track of February LOWS of the Alberta type, attended by stormy weather in the Pacific Northwest, and calling for south-warnings at most ports from the Columbia River north.

By the 25th the high pressure area referred to had moved far enough north to preclude the invasion of this district by further disturbances, and generally fair and settled weather prevailed in all sections until the close of the month.

There was a total absence of damaging frosts. General warnings were issued on occasions, but the frosts that followed were local in character and devoid of serious effects.—*Thomas R. Reed.*

RIVERS AND FLOODS

By H. C. FRANKENFIELD

The great ice gorge in the upper Allegheny River of Pennsylvania continued throughout the month. Under the influence of moderately heavy rains and melting snows on February 25 and 26, the ice moved out of Tionesta and French creeks, tributaries of the Allegheny River above Franklin, Pa., during the afternoon and evening of February 26, and also in the main river several miles above Warren, Pa. It was not long before the small channels in the large gorge between Franklin and Brandon, Pa., 15 miles, became jammed with ice; the water and floating ice backed up over the low sections of Franklin and the top of the ice at the Franklin gage was at the height of 24 feet, or 9 feet above the flood stage. The actual water stage is unknown, but it is estimated that the floating ice was at least 4 or 5 feet in depth. By the morning of February 27 the top of the ice at Franklin stood at 22.1 feet on the gage and the river was full of ice from Tionesta Creek to Brandon, a distance of 41 miles. From Tionesta Creek to Warren, a distance of 25 miles, the river was practically free of ice, but from Kinzua Creek, 8 miles above Warren, another gorge extended northward for about 18 miles. It was not until March 6 that the ice surface at Franklin fell below 15 feet on the gage, with an estimated water depth of not more than 3 feet.

The rise on February 26 resulted in loss and damage amounting to about $40,000. Efforts were made to open a channel with thermite and dynamite, but without much success, and the ice will probably remain until it moves out naturally.

While floods occurred quite generally over the southeastern portions of the country, they were uniformly moderate. (See table.) The flood in the Santee of South Carolina, which began on January 21, continued until February 22. After an interval of one week another

heavy rain raised the river above the flood stage, and it remained so at the close of the month. In other southern rivers, except the lower Altamaha, the floods did not continue for more than a day or two, and, in keeping with the previous history of moderate winter floods in the Southeast, the loss and damage was virtually nothing. In several localities the floods were of distinct benefit to the logging industry. Warnings were issued whenever necessary.

A moderate flood in the Monongahela River on February 15 caused some slight damage to construction work, the timely warnings preventing any loss of consequence.

Owing to the general rains of February 25 and 26, there was more or less movement of ice, with some gorges, in the interior rivers of the State of Ohio, except the Miami, and moderate harmless floods resulted. Warnings covering the situation were issued. There was also a small flood in the upper Wabash River of Indiana and the upper Illinois River at the same time, and again without damage of consequence.

Very heavy rains during the first week of the month caused a decided rise in the Sacramento River of California and its tributaries. The rivers were at summer stage, yet although there was no danger of extreme floods, warnings for sharp rises were issued for the benefit of farmers and others having cattle and other property in the lowlands. On account of the preceding dry season there were greater numbers of cattle and sheep than usual at this time of the year, and the warnings permitted the saving of these without loss.

The same general rains and moderate floods extended northward through the drainage area of the Willamette River of Oregon, and the experiences were much the same as in the Sacramento area. Warnings were issued promptly and were well verified. Cattle and property were taken from the lowlands, and there was little loss and damage. The revetment at the new highway bridge at Harrisburg was damaged and the mills at Oregon City were compelled to close for a few days, resulting in some loss of production and wages.

At the close of the month the snow cover in portions of eastern New York and in northern New England was of unusual depth. In the latter district the average depth ranged from 18 to 37 inches. At First Connecticut Lake, Pittsburg, N. H., the average depth of snow on the ground was 37 inches and its apparent water content about 7.75 inches, and this extends into much of northern and central Maine. There is potential material available for a severe flood. Its disposition awaits the temperature and rain of the coming month.

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
Atlantic drainage	*Feet*			*Feet*	
Schuylkill, Reading Pa	10	25	26	11.4	Feb. 26
Roanoke, Weldon, N. C	30	5	5	33.4	5
Tar, Tarboro, N. C	18	8	8	18.0	8
Neuse, Smithfield, N. C	14	4	7	16.9	5
Peedee, Mars Bluff, S. C	17	5	11	19.0	8
Santee:					
Rimini, S. C	12	(1)	13	14.3	Jan. 25
		20	(2)	13.4	Feb. 28
Ferguson, S. C	12	(1)	14	13.4	Jan. 26
		22	(2)	12.7	Feb. 26-28
Broad, Blairs, S. C	15	26	26	15.0	26
Saluda, Chappells, S. C	14	26	26	14.8	26
Ocmulgee, Macon, Ga	18	26	26	18.5	26
Altamaha:					
Charlotte, Ga	15	1	1	15.8	1
Everett City, Ga	10	1	13	11.2	5-6
East Gulf drainage	*Feet*			*Feet*	
Pearl, Jackson, Miss	20	(1)	3	26.2	Jan. 19
West Pearl, Pearl River, La	13	(1)	10	15.1	23
		23	27	14.3	Feb. 25
Great Lakes drainage					
Maumee:					
Fort Wayne, Ind	15	26	27	16.0	26
Napoleon, Ohio	10	26	(2)	13.6	27
St. Joseph, Montpelier, Ohio	10	27	(2)	12.4	27
Mississippi drainage					
Allegheny, Franklin, Pa	15	26	(2)	24.0	26
Monongahela, Lock No. 15, Hoult, W. Va.	22	15	15	22.0	15
Shenango, Sharon, Pa	9	27	27	9.7	27
Muskingum, McConnelsville, Ohio	22	4	5	23.4	4
Tuscarawas:					
Gnadenhutten, Ohio	9	3	3	9.2	3
		20	21	9.6	20
		26	(2)	13.5	27
Coshocton, Ohio	8	26	(2)	10.6	27
Walhonding, Walhonding, Ohio	8	26	27	11.6	26
Scioto:					
Larue, Ohio	11	26	26	11.1	26
Circleville, Ohio	10	27	27	11.0	27
Green, Lock No. 2, Rumsey, Ky	34	(1)	1	38.3	Jan. 29
White, East Fork, Seymour, Ind	10	15	15	11.4	Feb. 15
White, West Fork, Edwardsport, Ind	15	16	18	17.0	17
		27	(2)	18.3	28
Wabash, Lafayette, Ind	11	26	(2)	16.2	27
Illinois:					
Morris, Ill	13	26	27	14.9	26
Peru, Ill	14	25	(2)	17.8	27
Black, Corning, Ark	11	(1)	1	12.3	Jan. 25
		27	(2)	11.9	Feb. 28
Grand, Chillicothe, Mo	18	19	19	18.0	19
Cache, Patterson, Ark	9	(1)	8	9.9	1-2
Pacific drainage					
Sacramento, Calif., Red Bluff, Calif	23	5	5	23.5	5
Willamette:					
Eugene, Oreg	12	5	7	[3] 15.0	6
Albany, Oreg	20	7	9	24.7	8
Salem, Oreg	20	8	9	20.3	8
Santiam, Jefferson, Oreg	10	6	8	14.0	7
		25	26	10.5	25
Yamhill, McMinnville, Oreg	35	8	8	36.2	8

[1] Continued from last month. [2] Continued at end of month. [3] Estimated.

MEAN LAKE LEVELS DURING FEBRUARY, 1926

By UNITED STATES LAKE SURVEY

[Detroit, Mich., March 8, 1926]

The following data are reported in the "Notice to Mariners" of the above date:

Data	Lakes [1]			
	Superior	Michigan and Huron	Erie	Ontario
Mean level during February, 1926:	*Feet*	*Feet*	*Feet*	*Feet*
Above mean sea level at New York	600.20	577.43	569.93	244.10
Above or below—				
Mean stage of Januray, 1926	−0.29	+0.05	−0.11	−0.18
Mean stage of February, 1925	−0.69	−0.75	−0.57	−0.31
Average stage for February last 10 years	−1.53	−2.17	−1.44	−1.03
Highest recorded February stage	−2.28	−5.29	−3.82	−3.57
Lowest recorded February stage	−0.56	−0.75	−0.57	+0.27
Average departure (since 1860) of the February level from the January level	−0.18	+0.03	−0.08	+0.06

[1] Lake St. Clair's level: In February, 1926, 571.66 feet.

THE EFFECT OF WEATHER ON CROPS AND FARMING OPERATIONS, FEBRUARY, 1926

By J. B. KINCER

General Summary.—Temperatures during February were generally favorable for agricultural interests, except that the warm weather prematurely advanced fruit buds in the Southern States, especially in the area between the lower Mississippi Valley and the Rocky Mountains, and in the Pacific coast sections. Throughout the trans-Mississippi States the month was nearly ideal for outdoor seasonal operations and plowing and preparations for spring planting made splendid progress in central and southern districts; in the North the warm, springlike weather permitted livestock to graze freely on the range, with a consequent saving of much feed.

East of the Mississippi River there was much interruption to field work by wet weather, especially in the Southern States, and at the close of the month preparations for spring planting had become somwhat behind an average season, though seeding made good progress in Florida during the latter part. In the Pacific Coast States substantial rainfall the latter part of January and early in February was very beneficial, and vegetation, under the influence of increased moisture and continued warm weather, made unusually rapid advance. The month was also favorable for livestock interests throughout the great western grazing sections.

Small grains.—While there was very little protection by snow over much of the Winter Wheat Belt, February, in general, was rather favorable for fall-sown grains. There was no material harm from heaving in the eastern belt, but at the same time late-sown wheat in that area showed rather poor condition. In parts of the Plains States, particularly in the western portion, more moisture was needed, but winter wheat was benefited by rain or snow during the latter half of the month. The seeding of spring oats made slow progress in Southeastern States, but good advance was reported from the Southwest, with this work nearly finished in Oklahoma at the close of the month. Some spring wheat was seeded in the northern Great Plains considerably earlier than usual.

Corn and cotton.—In the Southeastern States plowing and preparation for planting corn and cotton were considerably interrupted by frequent rains and continued wet weather, but in the west Gulf area and southern Great Plains conditions were more favorable and much plowing was accomplished. Corn planting was active in Florida the latter part of the month, and some had come up at the close. There was also a small amount of cotton planted in the extreme southern portions of the belt.

Pastures and miscellaneous crops.—In east Gulf States pastures made fair progress, and good advance was reported from west Gulf sections, except that rain was needed in northern and western Texas. The range was in good condition in the Great Plains region, and rains or snows were very beneficial in most sections west of the Rocky Mountains, especially in the Pacific coast area. The mild temperatures and absence of severe storms were generally favorable for livestock over the western half of the country, and they were in mostly good to excellent condition.

Fruit trees advanced prematurely in the Southern States, with the blooming of early varieties general in most southern districts at the close of the month, and peaches were beginning to bloom as far north as the Fort Valley district of Georgia. In the Pacific Coast States the warm weather prematurely advanced buds, with almond and lemon trees in full bloom, and other early varieties of fruit coming into bloom in southern portions.

Hardy truck crops made fairly good advance in the Southeast, but spring planting was considerably interrupted. Some potatoes were planted, however, as far north as the eastern shore of Virginia. In the southern trans-Mississippi States the seeding of early spring crops progressed favorably and some gardens were made as far north as Kansas. At the close of the month, however, rain was needed in much of the west Gulf area.

CLIMATOLOGICAL TABLES[1]

CONDENSED CLIMATOLOGICAL SUMMARY

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from station that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by sections, February, 1926

Section	Temperature: Section average	Temperature: Departure from the normal	Monthly extremes: Station	Highest	Date	Station	Lowest	Date	Precipitation: Section average	Departure from the normal	Greatest monthly: Station	Amount	Least monthly: Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	51.3	+3.0	4 stations	80	14	Milltown	20	12	4.42	−0.88	Citronelle	7.85	Riverton	2.06
Arizona	50.1	+2.2	Camelback	88	9	Bright Angel Ranger Station.	−16	18	0.68	−0.48	Pinal Ranch	2.35	2 stations	0.00
Arkansas	48.5	+5.7	Huttig	88	7	Cravette	10	19	2.02	−1.33	Little Rock	3.52	Fayetteville	0.61
California	51.1	+2.8	Bonita	92	26	Helm Creek	−14	[2] 6	5.91	+1.71	Kennett	18.87	4 stations	0.00
Colorado	31.9	+5.6	Lamar	75	20	Dillon	−20	22	0.75	−0.37	Corona	5.40	Haswell	0.00
Florida	60.4	−0.1	Davie	90	26	Middleburg	23	12	2.21	−0.83	Vernon	11.12	Homestead	0.14
Georgia	50.8	+2.8	Valdosta	82	15	Clayton	15	11	4.54	−0.46	Bainbridge	8.37	St. George	2.43
Idaho	34.1	+5.8	2 stations	71	27	Stanley	−21	14	2.19	+0.58	Roland	6.74	Oakley	0.18
Illinois	35.0	+6.5	White Hall	71	28	Mount Carroll	2	11	2.40	+0.52	Mount Vernon	4.13	La Harpe	1.29
Indiana	34.5	+4.9	Vevay	75	22	Richmond	1	11	2.85	+0.31	Butlerville	5.56	Frankfort	0.70
Iowa	31.2	+8.6	Washington	67	28	Boone	−2	19	0.76	−0.44	Clinton	2.13	Inwood	0.04
Kansas	41.1	+8.6	Winfield	81	13	Olathe	4	19	0.78	−0.35	Clay Center	2.40	Norton (near)	T.
Kentucky	41.2	+5.2	2 stations	70	[2] 14	Williamstown	4	11	3.14	−0.39	Oneonta	5.87	Hopkinsville	1.27
Louisiana	56.0	+3.0	Ludington	84	14	Kelly (near)	23	11	2.67	−1.90	Melville	5.38	Natchitoches	0.50
Maryland-Delaware	34.4	+1.4	La Plata, Md	68	22	Oakland, Md	−5	6	3.98	+0.94	Grantsville, Md	5.95	Western Port, Md	2.97
Michigan	22.2	+3.8	St. Joseph	50	28	Humboldt	−32	21	2.15	+0.44	Saugatuck	4.60	St. James	0.45
Minnesota	20.1	+9.3	2 stations	52	28	2 stations	−22	[2] 16	0.54	−0.22	Morris	1.72	4 stations	T.
Mississippi	52.8	+4.5	Columbia	84	14	4 stations	21	[2] 11	3.06	−1.87	Fruitland Park	7.40	Pontotoc	0.59
Missouri	39.4	+7.6	Kidder	76	28	Downing	−4	18	2.08	−0.07	Doniphan	4.39	Seymour	0.53
Montana	32.4	+11.2	Foster	67	27	Hebgen Dam	−17	14	0.69	−0.02	Trout Creek	3.73	Chinook	0.00
Nebraska	35.6	+10.5	Alma	72	28	Gordon	1	1	0.30	−0.42	Auburn	1.53	3 stations	0.00
Nevada	39.4	+4.2	Las Vegas	84	28	Millett	6	21	0.75	−0.15	Lamoille	2.31	2 stations	0.00
New England	20.4	−1.2	Chestnut Hill, Mass.	54	27	Pittsburg, N. H	−28	9	4.17	+0.99	Blue Hill, Mass	7.03	Bloomfield, Vt	1.63
New Jersey	29.4	−0.2	Belleplain	57	18	Layton	−11	9	4.54	+0.84	South Orange	6.30	Cape May City	2.86
New Mexico	40.8	+3.3	Carlsbad	82	20	Virsylvia	−12	19	0.15	−0.47	Aspen Grove Ranch.	1.41	29 stations	0.00
New York	21.5	−0.4	Ohioville	56	12	2 stations	−25	[2] 8	3.42	+0.64	Mount Vernon	7.11	Sherburne	1.33
North Carolina	45.0	+3.2	6 stations	76	[2] 14	Parker	−1	11	4.04	−0.02	Edenton	5.97	Cullowhee	2.32
North Dakota	22.3	+14.4	Berthold Agency	58	27	Hansboro	−19	1	0.41	−0.08	Fullerton	1.44	2 stations	T.
Ohio	31.7	+2.8	Portsmouth	68	21	Peebles	−3	11	3.07	+0.63	Kings Mills	6.17	North Bass Island	1.21
Oklahoma	47.9	+8.6	2 stations	83	[2] 12	Kenton	12	19	0.52	−1.00	Antlers	3.05	11 stations	0.00
Oregon	43.1	+5.5	do	75	[2] 2	2 stations	9	[2] 12	5.51	+1.77	Mapleton	24.04	Lake	0.30
Pennsylvania	28.7	+1.0	Hanover	65	23	do	−13	12	4.06	+1.40	Freeland	7.29	Brookville	1.34
South Carolina	49.3	+2.1	3 stations	78	16	Caesars Head	12	11	3.99	−0.32	Georgetown	5.70	Chappells	2.70
South Dakota	29.0	+11.3	Academy	71	27	McIntosh	−17	2	0.22	−0.41	Harveys Ranch	1.60	6 stations	0.00
Tennessee	44.7	+3.9	Coldwater	76	14	Rugby	10	12	2.67	−1.42	Elkmont	4.96	Perrysville	1.15
Texas	55.9	+5.4	Encinal	95	12	Lieb (near)	13	2	0.34	−1.52	Finley	2.06	57 stations	0.00
Utah	34.6	+4.8	St. George	74	[2] 8	2 stations	−20	[2] 18	1.61	+0.23	High Line City Creek.	6.12	3 stations	T.
Virginia	40.1	+2.9	Diamond Springs	76	[2] 25	Burkes Garden	−5	12	3.70	+0.57	Mount Weather	6.47	Staunton	1.45
Washington	41.4	+6.6	2 stations	70	27	Snyders Ranch	6	14	4.60	+0.83	Spruce	17.70	Hanford	0.57
West Virginia	34.9	+2.6	Glenville	72	25	Wardensville	−3	6	4.01	+0.89	Bayard	8.88	Camden-on-Gauley	1.20
Wisconsin	21.3	+5.8	Port Washington	54	24	Long Lake	−34	11	1.67	+0.56	Stevens Point	4.04	River Falls	0.68
Wyoming	28.2	+6.3	2 stations	63	[2] 7	Moran	−31	15	0.60	−0.16	Riverside	2.34	2 stations	0.00
Alaska, January	28.4	+15.4	4 stations	54	[2] 6	Allakaket	−44	21	8.49	+4.42	Latouche	34.96	Wonder Lake	0.02
Hawaii	69.5	+1.3	Pupukea	89	7	2 stations	44	2	3.77	−2.78	Awini	19.91	Puuloa	0.00
Porto Rico	74.7	+1.3	Comerio Falls	94	28	Aibonito	49	5	2.50	−0.38	Rio Grande	7.88	Santa Rita	0.00

[1] For description of tables and charts, see REVIEW, January, 1926, page 32.

[2] Other dates also.

TABLE 1.—*Climatological data for Weather Bureau stations, February, 1926*

Districts and stations	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with .01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In	°F.	F.	°F.		°F	°F.		°F.	°F.	°F.	°F.	%	In.	In		Miles.								0-10	In.	In
New England							23.6	-1.7										74	4.04	+0.7										5.9		
Eastport	76	67	85	29.67	29.76	-.22	20.0	-1.5	41	19	27	-1	21	14	22	19	14	78	3.61	0.0	15	10,996	w.	45	ne.	1	7	7	14	6.3	28.4	12.7
Greenville, Me.	1,070	6		28.59	29.80		14.0		38	26	23	-13	21	5	35				3.45		14	6,996	nw.	36		11	11	8	9		34.5	
Portland, Me.	103	82	117	29.71	29.84	-.18	22.2	-1.6	44	26	30	4	9	15	26	20	14	71	5.19	+1.5	14	7,197	nw.	36	n.	4	13	6	9	5.2	28.8	8.0
Concord	289	70	79	29.51	29.84	-.20	20.9	-1.9	41	26	29	-8	9	12	39				2.57	-0.7	11	5,043	nw.	25	nw.	5	16	3	9	4.7	24.1	9.5
Burlington	403	11	48	29.44	29.92	-.11	14.9	-4.5	36	26	23	-12	9	7	28				1.85	+0.5	12	6,141	n.	35	s.	25	5	6	17	7.1	18.2	13.0
Northfield	876	12	60	28.89	29.88	-.16	13.8	-2.6	38	13	25	-20	9	3	41	11	8	82	2.32	+0.1	13	4,925	n.	32	n.	11	6	7	15	6.7	22.3	16.5
Boston	125	115	188	29.68	29.82	-.22	27.8	-1.0	48	25	35	11	11	20	22	24	16	64	5.56	+2.1	12	8,411	nw.	37	n.	4	10	6	12	5.7	27.6	1.6
Nantucket	12	14	90	29.77	29.78	-.26	30.2	-0.5	48	25	36	14	11	24	22	28	24	78	3.99	+0.9	11	13,441	nw.	77	ne.	4	9	4	15	6.5	6.1	0.0
Block Island	26	11	46	29.78	29.81	-.25	29.2	-1.2	46	25	35	13	11	24	19	27	22	74	4.42	+0.1	11	16,811	nw.	66	ne.	4	8	10	10	5.5	11.1	0.0
Providence	160	215	251	29.65	29.83	-.22	27.3	-1.7	48	25	35	9	11	20	23	24	18	67	3.82	-0.6	9	10,295	nw.	52	n.	4	9	6	13	6.0	15.8	T.
Hartford	159	122		29.67	29.86	-.20	26.2	-1.0	47	25	34	6	9	19	24				5.16	+1.6	12		nw.				9	6	13	5.7	32.7	1.7
New Haven	106	74	153	29.74	29.86	-.21	27.4	-1.6	47	25	34	9	11	21	24	25	20	75	5.95	+2.2	10	8,034	nw.	46	ne.	4	9	8	11	5.4	22.5	T.
Middle Atlantic States							33.6	+0.2										73	3.72	+0.5										6.2		
Albany	97	102	115	29.78	29.90	-.17	21.6	-2.5	44	26	29	-8	9	14	35	20	16	79	4.24	+1.7	11	5,417	nw.	30	s.	25	10	2	16	6.4	32.3	8.8
Binghamton	871	10	84	28.93	29.89	-.19	23.2	-0.8	50	18	32	-4	9	15	36				4.25	+2.4	11	4,892	nw.	32	sw.	26	2	11	15	7.6	29.4	4.0
New York	314	414	454	29.53	29.88	-.20	29.4	-1.9	50	25	36	8	11	22	24	26	20	69	5.46	+1.7	12	14,790	nw.	62	nw.	19	8	6	14	6.9	25.7	T.
Harrisburg	374	94	104	29.50	29.92	-.17	30.4	+0.2	48	25	37	11	11	24	26	27	22	73	4.81	+2.1	11	5,007	nw.	29	sw.	26	7	5	16	6.6	23.9	T.
Philadelphia	114	123	190	29.78	29.91	-.19	33.6	-0.3	53	25	40	14	11	27	24	30	25	71	3.18	-0.2	11	7,353	nw.	35	sw.	25	8	7	13	6.2	15.4	0.0
Reading	325	81	98	29.54	29.91		31.2		53	25	38	14	11	25	24	29	25	79	3.82	+0.3	13	5,548	nw.	28	se.	25	8	4	16	6.6	22.3	T.
Scranton	805	111	119	29.01	29.91	-.17	25.4	-1.9	51	18	33	6	9	18	31	23	19	78	3.61	+0.9	11	5,317	nw.	32	sw.	26	1	9	18	8.2	21.8	0.8
Atlantic City	52	37	172	29.83	29.80	-.22	33.8	+0.2	52	26	40	11	11	28	21	31	27	79	3.02	-0.2	10	14,495	w.	78	ne.	4	11	3	14	5.5	5.9	0.0
Cape May	17	13	49	29.91	29.93	-.18	34.8	+0.7	52	26	41	17	11	29	20	31	28	80	2.86	-0.4	10	7,684	nw.	42	ne.	3	8	7	13	6.1	5.0	0.0
Sandy Hook	22	10	55	29.84	29.87		29.8		48	18	35	11	11	24	19	27	22	73	4.04		11	14,088	nw.	66	s.	25	8	4	16	6.5	18.8	T.
Trenton	100	159	183	29.67	29.88		30.1		53	25	37	9	11	23	28	27	22	70	3.92	+0.7	11	9,470	nw.	49	ne.	3	9	5	14	6.4	23.2	0.0
Baltimore	123	100	113	29.77	29.91	-.20	35.6	+0.2	57	25	42	15	11	29	23	32	28	74	4.27	+0.8	13	4,310	nw.	31	s.	25	9	5	14	6.2	14.2	0.0
Washington	112	62	85	29.79	29.92	-.19	36.5	+1.2	62	25	44	15	11	29	29	32	26	68	4.17	+0.8	13	5,788	nw.	34	w.	26	7	7	14	6.4	11.8	0.0
Cape Henry	18	8	54	29.89	29.91		43.2		73	22	51	25	11	35	32	38	33	74	3.03	-0.7	10	10,324	nw.	53	nw.	4	10	9	9	5.3	0.3	0.0
Lynchburg	681	153	188	29.18	29.94	-.17	42.8	+2.5	69	22	53	20	11	33	38	35	28	63	3.59	+0.1	9	6,908	nw.	44	n.	19	10	11	7	5.3	1.5	0.0
Norfolk	91	170	205	29.84	29.94	-.17	44.2	+1.5	72	25	53	21	11	35	35	38	32	68	2.50	-1.2	8	10,855	nw.	51	se.	25	11	8	9	5.1	0.1	0.0
Richmond	144	11	52	29.78	29.94	-.17	41.8	+2.2	73	25	52	17	11	32	39	36	30	69	3.60	+0.5	10	6,938	sw.	42	s.	25	13	10	5	4.5	1.4	0.0
Wytheville	2,304	49	55	27.51	29.95	-.17	36.8	+1.7	59	21	46	13	11	28	31	32	27	70	2.95	-1.1	11	6,751	w.	40	sw.	25	6	11	11	6.1	7.6	T.
South Atlantic States							49.6	+1.8										73	3.30	-0.6										5.0		
Asheville	2,253	70	84	27.59	30.00	-.13	40.5	+2.0	67	14	51	16	12	30	36	34	29	70	2.50	-0.7	11	7,334	nw.	38	nw.	19	9	12	7	5.0	1.5	T.
Charlotte	779	55	62	29.12	29.97	-.15	46.2	+2.3	73	14	56	23	11	36	29	40	36	73	4.06	-0.3	8	5,004	sw.	27	sw.	14	11	7	10	4.9	T.	0.0
Hatteras	11	11	50	29.94	29.95	-.16	48.1	+0.7	64	25	55	30	12	41	21	44	40	78	3.67	-0.8	9	12,266	sw.	50	w.	4	11	8	9	5.4	0.0	0.0
Raleigh	376	103	110	29.55	29.96	-.15	46.2	+3.0	74	25	56	23	11	36	33	40	35	72	4.20	-0.1	5	7,190	sw.	40	se.	25	10	8	10	5.5	T.	0.0
Wilmington	78	81	91	29.90	29.99	-.13	50.2	+2.3	72	8	59	28	12	41	28	44	40	74	3.98	+0.6	6	6,411	w.	33	sw.	25	9	8	11	5.3	0.0	0.0
Charleston	48	11	92	29.96	30.01	-.11	53.0	+0.6	72	8	61	32	11	45	25	47	42	75	3.03	-0.4	6	8,035	sw.	35	e.	23	9	7	12	5.3	0.0	0.0
Columbia, S. C.	351	41	57	29.60	30.00	-.11	50.4	+2.2	73	14	60	26	12	41	29	43	36	66	3.16	-1.4	6	6,449	sw.	42	sw.	25	12	10	6	4.7	T.	0.0
Due West	711	10	55	29.22	30.00		47.2		75	14	57	23	12	37	30				3.78		9	8,043	w.	40	w.	27	12	5	11	4.7	T.	0.0
Greenville, S. C.	1,030	139	146	28.86	29.97		46.8	+3.5	74	14	56	25	11	37	31	40	35	72	4.58		7	8,037	sw.	50	w.	14	13	10	5	4.3	0.0	0.0
Augusta	182	62	77	29.81	30.00	-.12	51.9	+2.0	75	14	62	27	12	42	31	46	42	75	3.38	-1.0	6	5,145	nw.	35	w.	25	11	7	10	4.9	0.0	0.0
Savannah	65	150	194	29.96	30.03	-.09	54.8	+0.8	78	25	64	30	11	46	28	47	42	71	3.37	+0.1	6	10,686	w.	50	w.	3	13	4	11	4.7	0.0	0.0
Jacksonville	43	209	245	30.01	30.06	-.06	58.0	0.0	79	18	67	32	11	49	30	51	46	73	1.66	-1.8	7	9,833	sw.	45	w.	3	12	6	10	4.7	0.0	0.0
Florida Peninsula							66.1	-0.9										75	0.38	-1.9										3.0		
Key West	22	10	64	30.05	30.08	+.01	69.7	-0.8	83	26	76	51	12	64	21	63	60	78	0.19	-1.4	3	7,413	n.	43	nw.	3	20	6	2	2.8	0.0	0.0
Miami	25	71	79	30.06	30.09		66.9	-1.9	84	26	74	40	12	59	27	60	56	73	0.29	-1.8	5	4,507	nw.	26	sw.	19	13	11	4	3.9	0.0	0.0
Tampa	35	79	87	30.04	30.08	-.02	61.8	-0.1	82	24	71	38	12	53	28	54	50	74	0.65	-2.6	6	4,391	w.	28	sw.	19	16	8	4	3.7	0.0	0.0
Titusville	44	5		30.02	30.07		61.2		86	18	73	32	11	49	41				1.91		5		w.				24	2	2	1.4	0.0	0.0
East Gulf States							53.0	+1.8										71	4.30	-0.5										5.0		
Atlanta	1,173	190	216	28.77	30.02	-.10	47.2	+1.9	73	14	56	26	11	38	28	41	35	68	4.46	-0.2	9	9,130	nw.	44	nw.	9	11	6	11	5.3	T.	0.0
Macon	370	78	87	29.63	30.03	-.09	51.0	+1.7	76	14	61	24	12	41	32	44	38	67	5.04	+0.5	7	5,391	nw.	28	w.	25	11	6	11	5.1	T.	0.0
Thomasville	273	49	58	29.76	30.06	-.06	56.1	+1.1	78	25	67	29	12	45	31	48	43	72	6.81	+2.3	7	4,170	sw.	21	sw.	14	9	8	11	5.2	0.0	0.0
Apalachicola	36	42	49	30.03	30.07		56.6		74	25	64	32	11	49	26	52	49	81	1.81		8	5,728	w.	30	se.	2	14	9	5	3.9	0.0	0.0
Pensacola	56	149	185	30.01	30.07	-.04	56.6	+1.4	71	25	64	31	11	50	26	51	48	78	4.29	-0.2	6	10,066	w.	60	se.	2	9	8	11	5.4	0.0	0.0
Anniston	741	9	57	29.24	30.01	-.11	48.4	+2.6	76	14	59	24	20	38	37				3.65	-1.0	11	5,128	nw.	32	sw.	25	11	9	8	4.9	1.0	0.0
Birmingham	700	11	48	29.28	30.06	-.06	49.8	+1.8	76	14	60	26	11	40	32	43	37	66	3.23	-1.5	9	5,862	nw.	37	se.	24	10	8	10	5.0	T.	0.0
Mobile	57	125	161	30.00	30.06	-.05	55.8	+1.1	77	14	65	31	11	47	27	49	44	72	7.06	+1.7	5	7,606	nw.	42	sw.	24	9	8	11	5.3	0.0	0.0
Montgomery	223	100	112	29.81	30.07	-.05	53.2	+1.6	78	14	62	29	11	44	30	46	40	68	4.26	-1.3	10	5,691	nw.	31	w.	25	9	9	10	5.3	0.0	0.0
Corinth	469	6					49.4		76	14	60	24	11	39	37				2.10		8		nw.				2	22	4		T.	0.0
Meridian	375	85	93	29.65	30.06	-.05	52.0	+2.4	78	14	62	28	11	42	33	46	40	71	4.11	-0.8	5	4,770	w.	42	sw.	25	12	7	9	5.1	0.0	0.0
Vicksburg	247	65	73	29.78	30.07	-.03	54.5	+2.7	78	14	64	29	11	45	30	46	38	60	1.42	-3.2	4	6,014	sw.	48	nw.	24	12	5	11	5.0	0.0	0.0
New Orleans	53	76	84	30.02	30.08	-.01	58.8	+1.5	78	14	67	36	11	50	30	52	48	74	3.02	-1.4	4	4,680	sw.	29	n.	2	10	9	9	5.0	0.0	0.0
West Gulf States							56.4	+5.1										68	1.03	-1.7										4.2		
Shreveport	249	77	93	29.77	30.04	-.05	55.4	+4.5	77	13	65	32	11	46	31	48	42	66	1.89	-1.7	4	5,174	s.	30	w.	24	14	6	8	4.1	0.0	0.0
Bentonville	1,303	11	44				45.0	+6.5	72	13	55	19	19	35	31				1.62		3	4,637	n.	25	n.	18	15	7	6		1.5	0.0
Fort Smith	457	79	94	29.51	30.00	-.10	48.4	+5.6	74	13	59	27	11	38	36	42	35	67	1.32	-1.4	4	6,884	e.	40	w.	24	13	7	8	4.6	T.	0.0
Little Rock	357	136	144	29.63	30.02	-.09	49.2	+4.3	73	7	58	27	11	40	35	43	35	62	3.52	-0.7	4	7,745	s.	38	sw.	20	14	6	8	4.1	T.	0.0
Brownsville	57	53	61	29.97	30.03		65.9	+3.3	79	2	74	45	20	58	25	59	56	79	0.02		1	6,275	s.	34	s.	21	7	16	5	5.0	0.0	0.0
Corpus Christi	20	11	73	30.04	30.06	+.01	63.0	+4.6	81	24	70	42	20	56	27	57	53	77	0.40	-1.6	2	7,877	se.	46	se.	21	9	12	7	5.0	0.0	0.0
Dallas	512	109	117	29.48	30.04		55.6		81	13	67	29	19	44	36				0.10		3	6,300	s.	41	nw.	18	18	7	3	3.0	0.0	0.0
Fort Worth	670	106	114	29.30	30.02	-.05	54.8	+6.5	81	12	66	32	19	43	38	44	34	53	0.08	-1.4	3	6,595	nw.	44	w.	24	13	10	5	4.2	T.	0.0
Galveston	54	106	114	30.02	30.08	+.01	58.8	+2.5	71	14	64	38	19	53	21	54	52	83	1.27	-1.8	3	7,753	s.	50	nw.	18	11	14	3	3.9	0.0	0.0
Groesbeck	461	11	56	29.56	30.04		56.0		80	13	67	32	19	44	32				0.10		1	8,402	s.	50	w.	24	13	8	7	4.0	0.0	0.0
Houston	138	111	121	29.92	30.07		60.8	+4.9	81	14	70	38	19	51	28				1.20		4	5,670	s.	45	n.	26	13	11	4	4.0	0.0	0.0
Palestine	510	64	72	29.50	30.04	-.04	56.4	+5.2	77	13	67	31	19	46	30	47	38	57	0.49	-2.9	2	6,484	s.	29	nw.	19	13	10	5	4.1	0.0	0.0
Port Arthur	34	58	66	30.02	30.06		58.4		75	14	66	37	19	51	29	53	49	79	1.87		4	6,472	s.	33	nw.	19	12	7	9	4.5	0.0	0.0
San Antonio	693	119	132	29.32	30.05	.00	61.2	+5.8	81	14	73	38	19	49	37	51	43	61	0.08	-1.7	2	5,653	s.	46	nw.	18	15	10	3	3.7	0.0	0.0
Taylor	583	55	63	29.46	30.08	+.02	58.3	+7.0	85	13	71	34	19	46	37				0.21	-2.4	2	6,660	s.	42	nw.	18	9	13	6	4.9	0.0	0.0

TABLE 1.—*Climatological data for Weather Bureau stations, February, 1926*—Continued

Districts and stations	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with .01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles.								0–10	In.	In.
Ohio Valley and Tennessee							38.3	+2.2										75	2.93	−0.6										7.3		
Chattanooga	762	189	213	29.20	30.02	−.11	45.8	+1.7	74	14	55	22	11	37	29	39	33	62	3.31	−1.6	12	6,681	sw.	38	w.	9	7	13	8	5.5	0.3	0.0
Knoxville	995	102	111	28.92	30.00	−.12	44.2	+2.3	71	14	53	20	11	35	29	38	32	66	3.05	−1.8	12	5,778	sw.	36	sw.	25	9	4	15	6.0	T.	0.0
Memphis	399	76	97	29.59	30.02	−.09	48.4	+4.1	70	14	57	27	19	40	30	42	36	68	2.76	−1.6	7	7,000	sw.	52	w.	25	13	6	9	4.9	T.	0.0
Nashville	546	168	191	29.44	30.03	−.09	44.4	+2.8	70	14	54	22	11	35	37	39	34	70	2.06	−2.3	12	8,144	nw.	46	se.	24	8	5	15	6.4	0.5	0.0
Lexington	989	193	230	28.88	29.98	−.13	37.3	+1.9	61	21	45	10	11	29	34				2.27	−1.0	14	8,986	sw.	58	sw.	25	4	10	14	7.1	2.3	0.0
Louisville	525	188	234	29.41	30.00	−.11	39.1	+1.9	64	21	47	19	11	31	31	35	30	70	2.75	−1.0	11	8,852	w.	58	sw.	25	3	9	16	7.2	0.1	0.0
Evansville	431	139	175	29.52	30.00	−.11	40.4	+4.1	61	18	48	22	11	33	29	36	32	73	2.22	−0.8	10	9,057	sw.	56	sw.	25	2	13	13	7.2	0.5	0.0
Indianapolis	822	194	230	29.06	29.97	−.13	34.6	+3.5	59	21	41	16	11	28	30	31	28	79	2.75	−0.3	13	9,089	nw.	50	sw.	25	2	12	14	7.4	4.4	0.0
Royal Center	736	11	55	29.12	29.94		30.5		51	28	36	14	11	25	28				2.61		10	7,826	n.	47	sw.	25	2	8	18	8.1	7.6	0.0
Terre Haute	575	96	129	29.34	29.97		35.8		61	21	42	17	11	29	29	33	30	83	2.69		13	7,794	nw.	38	s.	25	3	8	17	7.5	1.1	0.0
Cincinnati	627	11	51	29.28	29.98	−.12	35.5	+2.7	61	21	43	9	11	28	30		30	80	3.35	+0.1	13	6,393	sw.	47	sw.	25	2	9	17	7.6	9.3	0.0
Columbus	822	179	222	29.05	29.95	−.14	32.4	+1.7	59	21	39	7	11	26	29	30	26	81	2.93	−0.1	10	7,751	nw.	44	sw.	25	3	4	21	8.4	6.1	0.0
Dayton	899	137	173	28.97	29.95		33.7	+2.3	59	21	40	9	11	27	28	31	27	77	2.51	−0.6	12	7,727	nw.	58	sw.	25	1	8	19	8.0	5.4	0.0
Elkins	1,947	59	67	27.84	29.96	−.14	32.8	+1.2	62	21	42	4	6	23	42	29	27	84	3.96	+0.8	19	5,168	w.	44	w.	25	1	7	20	8.5	24.0	T.
Parkersburg	637	77	82	29.29	29.96	−.14	35.6	+1.4	64	21	43	12	11	28	34	32	27	75	3.60	+0.4	13	5,043	nw.	32	sw.	25	3	5	20	8.4	7.7	0.0
Pittsburgh	842	353	410	29.00	29.93	−.16	31.8	−0.5	55	25	39	10	10	24	30	29	26	80	3.47	+0.8	18	8,727	sw.	57	sw.	25	1	3	24	8.9	17.2	T.
Lower Lake Region							24.1	−0.8										80	2.35	+0.1										7.8		
Buffalo	767	247	280	29.05	29.91	−.15	21.9	−2.4	46	25	28	4	11	16	27	21	18	85	2.18	−0.7	16	12,629	w.	86	sw.	26	2	11	15	7.8	17.6	4.5
Canton	448	10	61	29.39	29.90		11.8	−6.2	42	25	23	−22	21	1	43				1.71	−0.9	14	7,012	w.	38	e.	1	9	4	15	6.1	13.3	5.8
Oswego	335	76	91		29.91	−.15	21.2	−2.7	44	25	29	1	9	13	29			86	2.50	−0.1	18	7,635	nw.	37	sw.	26	1	7	20		31.4	18.0
Rochester	523	86	102	29.33	29.92	−.14	23.5	−1.1	45	25	30	7	11	18	28	21	17	74	2.28	−0.6	18	6,960	w.	37	w.	26	0	9	19	8.4	16.0	5.0
Syracuse	597	97	113	29.24	29.91	−.16	21.4	−2.4	46	25	28	2	11	15	26				3.44	+1.6	18	8,261	nw.	41	s.	25	3	5	20	7.9	25.8	8.0
Erie	714	130	166	29.12	29.92	−.15	25.3	−1.6	48	25	32	6	11	19	29	23	20	79	2.51	−0.3	18	9,189	w.	64	sw.	26	1	5	22	8.3	21.8	2.6
Cleveland	762	190	201	29.09	29.93	−.14	28.1	+0.7	51	25	35	11	11	22	28	26	22	80	2.53	−0.1	17	10,397	s.	50	w.	26	1	6	21	8.6	15.9	0.3
Sandusky	629	62	70	29.22	29.93	−.14	28.1	+0.7	51	25	34	8	11	23	25				1.98	−0.4	13	6,911	sw.	32	sw.	25	3	4	21	8.1	12.7	0.0
Toledo	628	208	243	29.24	29.95	−.12	28.0	+0.7	49	25	34	8	11	22	23	25	22	78	2.30	+0.3	13	9,769	nw.	66	sw.	25	6	4	18	7.5	14.0	0.0
Fort Wayne	856	113	124	28.98	29.94		30.4	+4.6	51	25	37	12	11	24	30	28	25	81	1.97		9	7,076	n.	38	sw.	25	5	3	20	7.9	8.6	0.0
Detroit	730	218	258	29.12	29.94	−.12	25.8	+0.5	45	25	31	9	11	20	22	24	20	80	4.05	+1.9	16	7,618	nw.	55	sw.	25	4	5	19	7.7	28.0	0.5
Upper Lake Region							21.6	+2.4										85	2.11	+0.4										7.6		
Alpena	609	13	92	29.26	29.95	−.08	19.0	+1.0	39	17	26	−2	21	12	27	18	15	82	1.85	+0.1	13	7,807	nw.	39	nw.	26	4	4	20	7.5	20.4	8.6
Escanaba	612	54	60	29.28	29.98	−.08	18.1	+2.7	34	14	26	−14	21	10	34	17	15	88	2.34	+1.0	15	6,211	n.	48	n.	25	8	5	15	6.6	25.3	12.0
Grand Haven	632	54	89	29.23	29.94	−.11	25.6	+1.4	43	28	31	7	21	20	29	24	22	86	2.98	+1.1	12	7,503	n.	47	w.	15	2	5	21	8.4	18.0	0.7
Grand Rapids	707	70	87	29.16	29.96	−.09	26.1	+2.4	47	28	32	8	23	20	27	24	20	80	2.93	+1.0	12	4,413	nw.	26	w.	15	4	2	22	8.4	16.9	T.
Houghton	668	62	99	29.22	29.98	−.07	16.6	+2.9	39	24	25	−14	21	8	40				1.07	−0.6	11	5,936	e.	36	w.	15	3	8	17	7.7	12.0	12.3
Lansing	878	11	62	28.96	29.93		23.4	+0.5	44	25	31	−4	23	16	35	22	21	91	3.46	+1.4	14	4,821	nw.	36	sw.	25	5	5	18	7.4	24.8	1.5
Ludington	637	60	66	29.22	29.94		24.7		40	24	30	4	21	20	23	23	20	83	2.21		11	7,128	n.	38	nw.	25	2	10	16	7.6	12.6	1.2
Marquette	734	77	111	29.14	29.97	−.08	18.9	+2.6	39	24	25	−4	21	13	26	17	15	86	1.36	−0.4	13	6,646	nw.	49	sw.	16	2	8	18	8.1	13.5	18.8
Port Huron	638	70	120	29.21	29.93	−.12	23.0	+0.3	43	25	29	6	23	17	26	22	19	86	2.43	+0.3	11	8,565	nw.	40	sw.	25	2	8	18	7.9	23.8	4.0
Saginaw	641			29.22	29.94		22.5	+0.6	42	25	30	−1	23	15	30				2.31		12		n.					5	3	20	18.4	1.8
Sault Sainte Marie	614	11	52	29.25	29.98	−.05	14.1	+1.5	33	25	23	−12	7	5	34	13	9	82	1.09	−0.3	11	5,336	nw.	33	n.	25	5	10	13	6.5	10.8	10.4
Chicago	673	7	131	29.22	29.96	−.12	30.9	+4.6	53	28	35	13	11	26	25	29	25	80	2.92	+0.8	11	8,663	nw.	38	ne.	18	4	4	20	7.9	9.0	0.0
Green Bay	617	109	141	29.26	29.95	−.11	21.1	+3.7	41	28	28	−3	11	14	32	20	18	88	1.59	0.0	11	7,284	n.	42	n.	25	3	9	16	7.6	16.7	4.0
Milwaukee	681	125	139	29.18	29.94	−.12	27.6	+4.8	46	28	33	10	19	22	27	26	22	78	2.39	+0.5	13	7,299	n.	28	ne.	18	4	5	19	7.8	15.8	0.3
Duluth	1,133	5	47	28.70	29.98	−.10	16.2	+4.8	37	25	24	−8	19	8	20	15	13	90	1.02	0.0	14	7,218	ne.	40	w.	14	8	3	17	6.5	11.2	5.0
North Dakota							22.6	+14.8										83	0.36	−0.2										6.7		
Moorhead	940	50	58	28.92	29.98	−.13	20.5	+12.4	44	5	28	−3	1	13	31	19	17	85	0.65	−0.1	12	5,565	n.	28	nw.	28	4	5	19	7.5	6.6	T.
Bismarck	1,674	8	57	28.15	30.00	−.12	24.6	+14.3	55	27	33	−4	1	17	29	22	19	80	0.35	−0.2	6	5,721	nw.	46	nw.	28	10	7	11	5.6	3.7	0.0
Devils Lake	1,478	11	44	28.32	29.96	−.15	19.2	+14.7	50	27	28	−6	20	11	26	18	15	86	0.25	−0.3	7	6,027	nw.	36	nw.	28	4	4	20	7.3	3.6	T.
Ellendale	1,457	10	56	28.34	29.96		23.3		53	27	32	−1	1	14	36				0.47		11	8,795	nw.	61	nw.	28	7	7	14	6.8	4.3	0.0
Grand Forks	835	12	89				18.4		50	27	26	−5	1	11	32	17			0.26		6		s.	46	nw.	28	10	8	10	6.7	2.5	T.
Williston	1,878	41	48	27.90	29.94	−.17	26.0	+17.9	54	27	34	−1	14	18	28	24	21	82	0.20	−0.3	4	5,478	w.	35	nw.	28	4	16	8	6.3	0.3	0.0
Upper Mississippi Valley							31.8	+7.2										79	1.52	−0.2										7.1		
Minneapolis	918	102	208	28.94	29.95		23.6	+7.7	50	28	31	6	14	16	33				0.55	−0.2	12	7,658	nw.	39	nw.	28	3	9	16	7.5	5.5	T.
St. Paul	837	236	261	29.02	29.96	−.13	23.3	+7.5	48	28	31	5	16	16	36				0.54	−0.3	11	7,753	nw.	40	nw.	28	1	14	13	7.1	8.3	T.
La Crosse	714	11	48	29.16	29.96	−.12	25.8	+6.6	50	28	33	1	11	18	37				1.45	+0.4	8	3,708	nw.	20	se.	5	4	7	17	7.7	13.2	3.0
Madison	974	70	78	28.88	29.97	−.10	25.6	+6.5	46	28	32	8	11	20	28	24	22	87	1.88	+0.4	13	6,545	nw.	31	s.	5	4	5	19	7.9	12.8	3.6
Wausau	1,247	4		28.57	29.96		19.5		43	28	27	−8	16	12	36				1.73		11		n.				6	3	19	7.4	21.7	10.0
Charles City	1,015	10	49	28.86	29.97	−.13	27.2	+10.1	53	28	34	9	4	20	30	25	23	85	0.58	−0.4	8	5,256	nw.	24	se.	16	5	8	15	6.7	4.6	T.
Davenport	606	71	79	29.29	29.98	−.12	32.2	+7.3	62	28	39	13	15	26	30	30	26	82	1.62	+0.1	8	5,385	nw.	26	s.	16	7	4	17	7.0	1.5	0.0
Des Moines	861	84	97	29.04	29.97	−.14	33.6	+9.9	63	28	41	11	19	26	29	30	26	75	0.82	−0.3	5	5,293	n.	34	sw.	5	5	8	15	6.9	3.4	T.
Dubuque	700	81	96	29.17	29.95	−.14	29.3	+7.1	55	28	36	9	11	23	31	27	24	80	1.14	−0.2	9	5,149	nw.	26	nw.	25	3	7	18	7.9	7.8	T.
Keokuk	614	64	78	29.29	29.98	−.13	35.1	+6.8	65	28	42	14	19	28	30	31	26	73	1.14	−0.5	5	6,048	nw.	35	w.	25	7	7	14	6.5	3.2	0.0
Cairo	358	87	93	29.61	30.00	−.12	43.0	+4.5	62	13	51	27	19	35	30	38	32	69	1.78	−1.6	11	7,624	s.	52	sw.	25	6	5	17	6.8	2.4	0.0
Peoria	600	11	45	29.30	29.98	−.12	33.4	+7.5	66	28	40	12	19	27	36	30	28	83	2.42	−0.3	9	5,324	nw.	30	w.	25	5	9	14	7.0	3.0	0.0
Springfield, Ill	636	10	91	29.27	29.96	−.14	35.6	+6.1	67	28	42	16	19	29	36	32	29	83	2.43	−0.3	9	6,539	w.	33	n.	18	7	5	16	6.7	1.0	0.0
Hannibal	534	74	109	29.40	29.98	−.13	36.8	+7.1	68	28	44	17	19	30	34				2.34	+0.7	8	6,722	w.	34	sw.	28	9	4	15	6.4	0.8	0.0
St. Louis	568	265	303	29.36	29.98	−.13	40.2	+5.7	69	28	48	20	19	32	37	35	29	69	2.52	−0.2	11	9,660	nw.	42	nw.	25	7	6	15	6.6	T.	0.0
Missouri Valley							35.9	+10.2										76	0.83	−0.2										5.7		
Columbia, Mo	784	11	84	29.13	29.98	−.13	38.7	+7.0	70	28	47	16	19	31	32				2.04	−0.1	8	6,667	w.	33	n.	18	9	3	16	6.5	2.8	0.0
Kansas City	963	161	181	28.93	29.98	−.13	39.2	+8.0	69	28	47	16	19	31	25	35	31	75	2.46	+0.9	4	8,375	nw.	58	ne.	18	7	12	9	5.4	10.8	0.0
St. Joseph	967	11	49	28.93	29.98		37.4		66	28	46	14	19	29	26	33	28	73	2.14		4	6,594	nw.	36	nw.	8	12	7	9	5.0	6.4	0.0
Springfield, Mo	1,324	98	104	28.59	30.02	−.09	41.2	+6.0	69	28	50	19	19	32	31	36	31	72	1.15	−1.1	6	8,509	nw.	37	sw.	28	13	2	13	5.2	2.7	0.0
Iola	984	11	50	28.92	30.00	−.10	41.8	+9.8	72	28	52	18	19	31	33				1.10	0.0	3	5,001	s.	30	n.	18	9	10	9	5.6	0.6	0.0
Topeka	987	92	107				39.3	+8.3	69	28	49	13	19	30	31				1.39	0.0	5	7,175	nw.	47	n.	18	11	9	8	5.0	8.0	0.0
Drexel	1,299	10	54	28.54	29.96		33.4		61	28	41	10	19	26	30				0.77		4	7,561	nw.	32	nw.	28	3	13	12	6.7	7.4	0.0
Lincoln	1,189	11	84	28.69	29.99	−.11	36.8	+10.7	65	28	46	16	19	28	29	32	28	76	0.74	0.0	4	7,715	n.	44	n.	28	6	9	13	6.6	2.3	0.0
Omaha	1,105	115	122	28.77	29.99	−.12	35.5	+10.0	62	28	43	18	15	28	26	31	26	73	0.77	0.0	3	6,494	nw.	36	n.	8	11	10	7	5.2	4.9	0.0
Valentine	2,598	47	54	27.20	29.97	−.12	35.0	+13.6	63	27	45	13	15	24	33	30	24	71	0.06	−0.5	2	6,808	w.	43	nw.	28	9	14	5	4.9	1.2	0.0
Sioux City	1,135	94	164	28.74	30.00	−.12	32.0	+11.0	58	28	39	11	1	25	26	29	26	81	0.09	−0.5	3	8,671	s.	46	nw.	28	4	14	10	6.4	0.5	0.0
Huron	1,306	59	74	28.56	30.00	−.12	27.2	+12.9	58	27	35	−5	1	20	31	25	22	82	0.04	−0.4	1	6,029	s.	34	n.	8	9	12	7	5.0	0.5	0.0
Pierre	1,572	70	75	28.27	29.99	−.12	31.8	+13.2	62	27	40	10	15	23	30	28	24	80	0.10	−0.3	5	6,076	nw.	44	nw.	28	4	10	14	6.5	0.7	0.0
Yankton	1,233	49	57	28.61	29.90	−.16	32.6	+11.7	63	27	41	6	15	24	37				0.06	−0.5	1	5,802	w.	36	nw.	28	3	17	8	6.1	0.5	0.0

TABLE 1.—*Climatological data for Weather Bureau stations, February, 1926*—Continued

Districts and stations	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature: Departure from normal	Temperature: Maximum	Temperature: Date	Temperature: Mean maximum	Temperature: Minimum	Temperature: Date	Temperature: Mean minimum	Temperature: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with .01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles.								0-10	In.	In.
Northern Slope							**32.8**	**+11.0**										**67**	**0.46**	**−0.3**										**5.8**		
Billings	3,140	5					37.6		62	19	50	10	14	26	33				0.26		6		nw.				12	6	10		2.3	
Havre	2,505	11	44	27.24	29.93	−.14	32.9	+19.3	60	26	42	6	14	23	33	29	25	75	0.27	−0.2	6	5,602	sw.	33	nw.	28	5	15	8	5.5	1.4	0.0
Helena	4,110	87	112	25.73	30.00	−.11	34.9	+11.9	57	27	43	4	14	27	26	30	23	65	0.47	−0.3	11	5,517	sw.	42	sw.	5	2	8	18	7.6	4.4	0.0
Kalispell	2,973	48	56	26.87	29.98	−.10	34.0	+10.7	56	27	41	11	14	27	32	31	27	77	0.63	−0.8	10	2,914	nw.	22	sw.	7	4	12	12	6.7	3.4	0.0
Miles City	2,371	48	55	27.40	30.01	−.08	33.6	+16.8	62	27	43	9	3	24	31	29	24	71	0.60	0.0	7	4,243	nw	39	w.	28	8	16	4	4.9	4.6	0.0
Rapid City	3,259	50	58	26.51	30.01	−.07	34.8	+11.4	63	27	46	9	14	24	33	29	22	63	0.16	−0.3	6	5,201	nw.	42	nw.	8	7	13	8	5.5	1.6	0.0
Cheyenne	6,088	84	101	23.91	30.00	−.03	33.2	+5.9	54	7	42	12	18	24	27	27	19	58	0.61	0.0	5	11,093	w.	60	w.	5	8	12	8	5.7	5.1	T.
Lander	5,372	60	68	24.58	30.08	.00	27.0	+4.5	52	6	40	1	15	14	39	22	14	59	0.26	−0.4	4	3,136	w.	44	sw.	5	7	19	2	4.7	2.6	1.0
Sheridan	3,790	10	47	26.02	30.00		33.4		62	27	45	7	14	22	37	28	22	68	0.64		8	3,492	nw.	33	nw.	25	6	17	5	5.5	5.7	0.0
Yellowstone Park	6,241	11	48	23.82	30.08	−.02	27.1	+7.5	47	28	35	3	14	20	26	24	19	71	1.05	−0.8	19	6,087	s.	39	sw.	4	4	10	14	7.2	13.0	6.4
North Platte	2,821	11	51	27.03	30.02	−.05	37.6	+11.0	65	27	50	13	15	25	38	30	24	67	0.12	−0.3	4	5,572	nw.	44	n.	8	11	10	7	4.9	1.0	0.0
Middle Slope							**42.1**	**+8.4**										**59**	**0.47**	**−0.3**										**4.6**		
Denver	5,292	106	113	24.66	30.00	−.01	39.0	+6.3	65	20	49	17	18	29	33	31	22	56	0.40	−0.1	4	5,629	s.	40	n.	25	8	15	5	4.7	3.8	0.0
Pueblo	4,685	80	86	25.22	29.96	−.04	41.6	+8.7	68	7	56	16	26	27	49	32	19	46	0.01	−0.5	1	6,084	w.	44	nw.	24	16	8	4	3.9	T.	0.0
Concordia	1,392	50	58	28.50	30.01	−.08	39.5	+9.7	67	28	49	18	19	30	29	33	26	65	0.97	+0.2	3	6,252	nw.	42	nw.	8	5	14	9	5.9	6.3	0.0
Dodge City	2,509	11	51	27.38	30.03	−.03	41.6	+8.4	71	28	56	17	19	27	41	33	25	63	0.97	+0.3	2	7,260	nw.	42	s.	11	14	9	5	3.7	6.8	0.0
Wichita	1,358	139	158	28.53	29.99	−.09	43.3	+8.9	73	28	54	20	15	32	33	36	28	63	0.44	−0.6	2	9,174	s.	42	s.	16	13	10	5	4.4	1.2	0.0
Broken Arrow	765	11	56	29.16	30.00		46.0		76	13	57	22	19	35	36				0.98		2	9,559	n.	52	n.	18	10	9	9	4.9	T.	0.0
Oklahoma City	1,214	10	47	28.70	30.01	−.06	47.8	+8.2	78	13	50	23	19	36	34	39	31	62	0.04	−0.9	2	7,741	n.	45	n.	18	13	9	6	4.4	T.	0.0
Southern Slope							**52.2**	**+6.3**										**42**	**0.02**	**−0.8**										**3.2**		
Abilene	1,738	10	52	28.20	30.03	−.02	54.4	+7.2	82	12	68	26	19	41	38	41	27	43	T.	−1.1	0	7,887	s.	39	nw.	18	15	7	6	3.6	0.0	0.0
Amarillo	3,676	10	49	26.24	30.00	−.02	46.4	+8.3	76	20	61	24	2	32	47	36	25	51	0.06	−0.8	1	8,186	sw.	42	nw.	18	17	8	3	3.1	0.6	0.0
Del Rio	944	64	71	29.06	30.06	+.06	59.5	+5.8	85	13	72	34	19	47	41				0.04	−0.8	2	5,859	se.	44	nw.	18	16	8	4	3.8	0.0	0.0
Roswell	3,566	75	85	26.36	29.98	.00	48.6	+6.1	79	11	65	19	19	32	51	36	17	32	0.00	−0.5	0	6,255	nw.	42	w.	17	19	7	2	2.5	0.0	0.0
Southern Plateau							**48.3**	**+3.5**										**45**	**0.20**	**−0.5**										**3.1**		
El Paso	3,778	152	175	26.23	30.04	+.09	51.5	+2.5	77	11	65	30	3	38	38	39	22	35	0.17	−0.3	1	5,558	nw.	44	w.	21	22	3	3	2.2	0.0	0.0
Santa Fe	7,013	38	53	23.22	30.02	+.04	36.8	+3.7	59	28	48	14	26	26	35	28	18	49	0.28	−0.6	3	5,047	n.	32	sw.	21	12	10	6	4.3	3.7	0.0
Flagstaff	6,907	10	59	23.35	30.02	+.02	35.0	+4.2	63	9	49	4	2	22	43	27		58	1.19		6	5,508	w.	32	sw.	12	18	6	4		11.8	0.0
Phoenix	1,108	10	82	28.86	30.03	+.04	58.1	+3.0	84	9	74	35	18	43	41	45	29	39	0.10	−0.6	1	3,037	e.	25	w.	1	17	8	3	3.0	0.0	0.0
Yuma	141	9	54	29.89	30.04	+.04	61.6	+3.0	85	28	76	42	19	48	37	49	36	45	0.02	−0.6	1	3,676	n.	25	n.	23	18	7	3	2.4	0.0	0.0
Independence	3,957	5	25	26.00	30.06	.00	46.8	+4.6	75	28	60	25	15	33	41	37			0.41	−0.4	3		nw.				10	8	10	3.8	0.0	0.0
Middle Plateau							**38.3**	**+4.9**										**62**	**1.18**	**+0.1**										**5.5**		
Reno	4,532	74	81	25.50	30.10	+0.2	39.9	+4.3	67	27	51	18	17	29	39	34	27	62	0.63	−0.6	8	3,777	w.	36	sw.	19	10	6	12	5.7	4.0	0.0
Tonopah	6,090	12	20				37.4		59	27	45	20	17	30	25	31	22	57	0.34		4		se.									
Winnemucca	4,344	18	56	25.67	30.12	+.03	38.4	+4.9	62	28	48	17	17	28	37	34	30	74	1.49	+0.6	12	4,720	sw.	36	sw.	4	8	16	4	5.0	10.8	0.0
Modena	5,479	10	43	24.65	30.06	+.02	36.0	+5.0	62	28	48	15	24	23	44	30	20	56	0.77	−0.4	8	6,550	sw.	42	nw.	16	10	9	9	4.9	5.0	0.0
Salt Lake City	4,360	163	203	25.67	30.10	+.02	39.0	+5.2	58	7	47	20	18	31	28	34	28	66	2.45	+1.1	9	3,918	s.	44	w.	12	5	7	16	7.0	20.3	0.0
Grand Junction	4,602	60	68	25.42	30.05	+.01	38.1	+5.2	60	8	49	21	24	27	34	31	23	59	0.54	−0.1	6	3,429	se.	29	sw.	12	9	10	9	5.1	2.3	0.0
Northern Plateau							**41.1**	**+8.1**										**73**	**1.78**	**+0.4**										**7.3**		
Baker	3,471	48	53	26.46	30.09	−.03	37.1	+8.1	56	27	45	21	14	30	27	34	30	78	1.19	−0.2	12	3,798	se.	50	sw.	4	4	9	15	6.4	4.7	0.0
Boise	2,739	78	86	27.22	30.12	.00	41.8	+7.0	60	27	49	26	14	34	29	37	31	66	2.42	+1.0	12	3,567	se.	23	se.	4	4	4	20	7.2	3.8	0.0
Lewiston	757	40	48	29.21	30.03	−.08	45.6	+8.6	71	27	54	27	14	37	33				2.12	+0.8	15	2,706	e.	28	w.	24	1	6	21	8.1	0.0	0.0
Pocatello	4,477	60	68	25.49	30.09	−.06	36.1	+7.2	55	28	48	16	14	29	24	32	27	71	0.96	+0.1	13	7,104	se.	40	sw.	24	4	9	15	7.0	5.4	0.0
Spokane	1,929	101	110	27.95	30.03	−.06	39.6	+8.3	60	26	46	24	14	33	28	37	33	78	1.87	−0.1	14	3,773	s.	29	sw.	5	1	9	18	7.7	2.5	0.0
Walla Walla	991	57	65	28.95	30.03	−.08	46.3	+9.2	67	27	53	30	14	39	29	41	36	71	2.14	+0.6	16	3,806	s.	38	w.	4	4	6	18	7.2	0.0	0.0
North Pacific Coast Region							**47.6**	**+5.8**										**82**	**5.75**	**+0.7**										**7.5**		
North Head	211	11	56	29.73	29.96	−.10	47.4	+4.4	59	8	52	38	12	43	17	45	43	85	7.32	+1.5	23	12,594	s.	84	sw.	4	3	2	23	8.6	0.0	0.0
Port Angeles	29	8	53		29.94		43.8		54	9	50	32	14	38	16				2.24	−0.8	19	3,807	sw.	34	w.	24	0	8	20		0.0	0.0
Seattle	125	215	250	29.83	29.96	−.10	46.8	+5.7	58	8	52	35	13	42	17	44	40	80	2.99	−0.7	19	7,283	s.	42	s.	23	3	4	21	7.9	0.0	0.0
Tacoma	194	172	201	29.75	29.96	−.10	46.6	+6.0	58	8	52	32	13	41	21				3.77	−0.4	19	6,685	s.	42	s.	4	4	9	15	6.8	0.0	0.0
Tatoosh Island	86	9	53	29.80	29.90	−.10	47.1	+6.1	60	9	51	36	23	44	13	45	44	88	9.43	+0.7	23	13,002	e.	79	s.	3	5	3	20	7.6	0.0	0.0
Yakima	1,071	5					41.2		66	27	52	23	14	30	40				1.36		6		sw.				7	10	11	6.1	T.	0.0
Medford	1,425	4					46.4		69	27	57	26	17	36	39	41	38	77	2.03		13		nw.				4	4	20		0.0	0.0
Portland, Oreg.	153	68	106	29.83	29.99	−.09	48.7	+6.6	65	28	54	37	13	43	24	46	44	83	7.71	+2.3	21	4,462	se.	33	sw.	4	2	4	22	8.6	0.0	0.0
Roseburg	510	9	57	29.48	30.04	−.06	49.1	+5.7	68	18	56	34	17	42	26	48	42	80	6.79	+2.2	19	2,129	s.	31	se.	2	0	16	12	7.0	0.0	0.0
Middle Pacific Coast Region							**53.4**	**+3.5**										**79**	**5.57**	**+1.6**										**6.1**		
Eureka	62	73	80	30.02	30.09	−.02	51.8	+4.6	64	26	58	38	17	46	22	49	46	82	6.64	−0.4	18	4,550	se.	41	sw.	4	2	4	22	8.0	0.0	0.0
Point Reyes	490	7	18	29.51	30.02		53.4	+4.2	75	26	58	43	13	49	20				2.71		15	14,678	s.	96	s.	2	7	7	14	6.3	0.0	0.0
Red Bluff	332	50	56	29.73	30.10	−.01	52.1	+2.7	81	28	60	32	20	44	37	48	43	74	4.93	+1.3	14	3,976	nw.	33	se.	4	9	8	11	5.6	0.0	0.0
Sacramento	69	106	117	30.02	30.09	.00	53.0	+2.9	73	25	59	39	17	46	23	50	47	81	5.52	+2.4	10	5,204	se.	30	se.	2	9	9	10	5.2	0.0	0.0
San Francisco	155	208	243	29.91	30.09	−.01	56.0	+3.8	75	25	62	45	12	50	22	51	47	78	5.40	+1.7	12	5,486	nw.	40	se.	2	10	7	11	5.5	0.0	0.0
San Jose	141	12	110	29.95	30.10		53.8	+3.0	77	26	64	36	23	44	34				5.35	+3.0	10	4,674	se.	29	se.	13	8	7	13	6.0	0.0	0.0
South Pacific Coast Region							**58.3**	**+4.6**										**69**	**3.33**	**+0.9**										**4.7**		
Fresno	327	80	98	29.76	30.12	+.04	54.2	+3.1	79	28	64	37	17	45	30	48	44	71	0.99	−0.3	10	3,996	nw.	28	s.	11	11	10	7	5.0	0.0	0.0
Los Angeles	338	159	191	29.70	30.07	+.01	61.2	+5.7	87	26	70	48	17	52	29	52	44	62	2.70	−0.2	8	3,653	ne.	22	w.	12	13	6	9	4.3	0.0	0.0
San Diego	87	62	70	29.97	30.06	.00	59.7	+4.6	87	26	68	47	22	51	33	53	49	74	2.33	+0.4	9	3,917	nw.	26	sw.	12	11	10	7	4.8	0.0	0.0
San Luis Obispo	201	32	40	29.88	30.10	−.01	58.2	+5.1	87	26	68	38	18	49	35	51	45	69	7.29	+3.7	12	3,674	n.	26	s.	2	11	8	9	4.8	0.0	0.0
West Indies																																
San Juan, P. R.	82	9	54	29.93	30.02		75.6	+0.7	88	11	81	65	6	70	17				1.88	−0.6	11	7,941	e.	34	e.	15	14	7	7	4.6	0.0	0.0
Panama Canal																																
Balboa Heights	118	7	97	29.74	29.86	−.01	81.6	+1.3	93	18	90	70	13	73	21	73	72	74	0.07	−0.7	1	8,678	nw.	34	n.	27	8	18	2	4.6	0.0	0.0
Colon	38	7	97	29.85	29.89	−.01	81.8	+1.7	88	2	86	74	9	77	12	75	73	77	1.78	+0.2	13	11,558	n.	29	n.	28	3	23	2	5.3	0.0	0.0
Alaska																																
Juneau	80	11	64				35.0		50	9	39	24	17	31	13	32	29	80	5.85		18	5,522	se.	39	se.	9	2	1	25	9.1	10.7	T.
Hawaiian Islands																																
Honolulu	38	86	100				72.4		81	24	77	65	16	68	15	65	61	70	0.44	−3.3	7	5,834	e.	36	ne.	18	9	15	4	4.5	0.0	0.0

TABLE 2.—*Data furnished by the Canadian Meteorological Service, February, 1926*

Stations	Altitude above mean sea level, Jan. 1, 1919	Pressure			Temperature of the air						Precipitation		
		Station reduced to mean of 24 hours	Sea level reduced to mean of 24 hours	Departure from normal	Mean max.+ mean min.÷2	Departure from normal	Mean maximum	Mean minimum	Highest	Lowest	Total	Departure from normal	Total snowfall
	Feet.	*In.*	*In.*	*In.*	°F	°F	°F	°F	°F	°F	*In.*	*In.*	*In.*
St. Johns, N. F.	125												
Sydney, C. B. I.	48												
Halifax, N. S.	88												
Yarmouth, N. S.	65												
Charlottetown, P. E. I.	38												
Chatham, N. B.	28												
Father Point, Que.	20	29.80	29.83	−.15	8.5	−3.0	15.1	1.9	32	−19	1.28	−0.93	12.8
Quebec, Que.	296	29.53	29.87	−.12	12.4	+0.6	18.0	6.8	31	−13	2.61	−0.66	25.9
Montreal, Que.	187	29.66	29.89	−.13	14.7	+0.2	21.4	8.0	37	−6	3.21	+0.14	31.1
Stonecliffe, Ont.	489												
Ottawa, Ont.	236	29.66	29.94	−.08	13.9	+2.2	23.9	3.9	37	−16	2.09	−0.60	19.6
Kingston, Ont.	285	29.59	29.93	−.11	17.7	−0.1	25.4	9.9	39	−7	1.77	−0.77	8.7
Toronto, Ont.	379	29.50	29.93	−.11	21.0	−0.5	27.7	14.3	40	1	2.95	+0.34	19.7
Cochrane, Ont.	930				4.7		13.8	−4.4	33	−24			
White River, Ont.	1,244	28.55	29.94	−.08	2.5	+2.3	17.7	−12.7	35	−43	0.56	−0.96	5.6
Port Stanley, Ont.	592												
Southampton, Ont.	656	29.19			17.1	−2.8	25.3	8.9	38	−8	2.59	−0.31	17.3
Parry Sound, Ont.	688	29.20	29.94	−.07	13.5	−0.8	23.0	4.0	36	−17	1.61	−1.31	15.1
Port Arthur, Ont.	644	29.24	29.98	−.07	13.2	+6.8	21.2	5.3	35	−15	1.10	+0.20	11.0
Winnipeg, Man.	760	29.11	29.98	−.12	12.8	+14.4	21.1	4.5	39	−20	0.60	−0.38	6.0
Minnedosa, Man.	1,690	28.06	29.96	−.13	12.7	+15.4	21.9	3.5	40	−21	0.36	−0.25	3.6
Le Pas, Man.	860				6.5		17.5	−4.5	40	−34	0.75		7.5
Qu'Appelle, Sask.	2,115	27.57	29.90	−.18	17.1	+17.7	24.9	9.3	42	−15	0.96	+0.23	9.6
Medicine Hat, Alb.	2,144	27.54	29.85	−.20	27.8	+16.6	36.9	18.7	60	−8	0.25	−0.42	2.5
Moose Jaw, Sask.	1,759				20.8		29.1	12.6	47	−13	1.07		10.5
Swift Current, Sask.	2,392	27.32	29.94	−.13	21.2	+13.2	29.4	13.1	47	−9	0.45	−0.29	4.5
Calgary, Alb.	3,428												
Banff, Alb.	4,521	25.21	29.88	−.10	28.0	+8.8	36.4	19.6	47	−1	0.38	−0.54	3.8
Edmonton, Alb.	2,150	27.49	29.84	−.18	19.4	+11.1	28.1	10.8	55	−12	0.30	−0.37	3.0
Prince Albert, Sask.	1,450	28.33	29.97	−.12	15.8	+18.8	26.0	5.6	45	−19	0.39	−0.30	3.9
Battleford, Sask.	1,592	28.11	29.91	−.18	15.3	+15.2	25.7	5.0	46	−24	0.53	+0.16	5.3
Kamloops, B. C.	1,262												
Victoria, B. C.	230	29.68	29.93	−.07	45.9	+6.4	50.4	41.5	57	37	2.41	−1.69	0.0
Barkerville, B. C.	4,180												
Triangle Island, B. C.	680												
Prince Rupert, B. C.	170												
Hamilton, Ber.	151	29.90	30.07	−.04	61.4	−0.1	67.7	55.2	73	47	4.36	−0.08	0.0

LATE REPORTS, JANUARY, 1926

Stations	Altitude	Station pressure	Sea level pressure	Departure	Mean	Departure	Mean maximum	Mean minimum	Highest	Lowest	Total	Departure	Total snowfall
St. Johns, N. F.	125	29.41	29.55	−.31	21.6	−2.2	27.1	16.2	44	0	5.84	−0.07	40.0
Sydney, C. B. I.	48	29.74	29.79	−.14	20.3	−0.2	28.7	11.8	44	−10	4.80	−0.20	25.5
Halifax, N. S.	88	29.73	29.84	−.13	23.5	+1.7	31.3	15.8	46	−6	5.24	−0.53	25.2
Yarmouth, N. S.	65	29.73	29.80	−.20	26.1	−0.2	33.1	19.1	45	1	5.85	+0.44	37.2
Charlottetown, P. E. I.	38	29.75	29.79	−.17	17.1	+0.1	24.2	10.0	40	−11	5.80	+1.84	50.5
Chatham, N. B.	28	29.72	29.76	−.21	11.5	+1.7	20.6	2.4	39	−23	3.50	−0.09	24.6
Port Arthur, Ont.	644	29.20	29.94	−.13	10.3	+7.2	17.7	2.9	35	−28	0.64	−0.18	6.1
Winnipeg, Man.	760	29.12	29.99	−.12	6.0	+12.8	14.5	−2.5	34	−29	0.40	−0.48	4.0
Minnedosa, Man.	1,690	28.08	29.99	−.11	9.5	+16.7	19.1	−0.1	40	−30	0.29	−0.51	2.7
Le Pas, Man.	860				1.0		9.9	−7.8	36	−37	0.35		3.5
Moose Jaw, Sask.	1,759				18.5		26.9	10.2	46	−17	0.41		4.1
Calgary, Alb.	3,428	26.36	30.03	.00	29.2	+20.8	39.9	18.5	51	0	0.28	−0.25	2.8
Kamloops, B. C.	1,262	28.90	30.24	+.28	28.8	+5.8	32.3	25.3	37	20	1.87	+1.05	18.7
Barkerville, B. C.	4,180	25.64	30.03	+.14	25.7	+7.9	31.5	20.0	40	10	2.35	−0.25	23.5

Chart I. Tracks of Centers of Anticyclones, February, 1926. (Inset) Departure of Monthly Mean Pressure from Normal.

(Plotted by Wilfred P. Day)

Chart II. Tracks of Centers of Cyclones, February, 1926. (Inset) Change in Mean Pressure from Preceding Month

(Plotted by Wilfred P. Day)

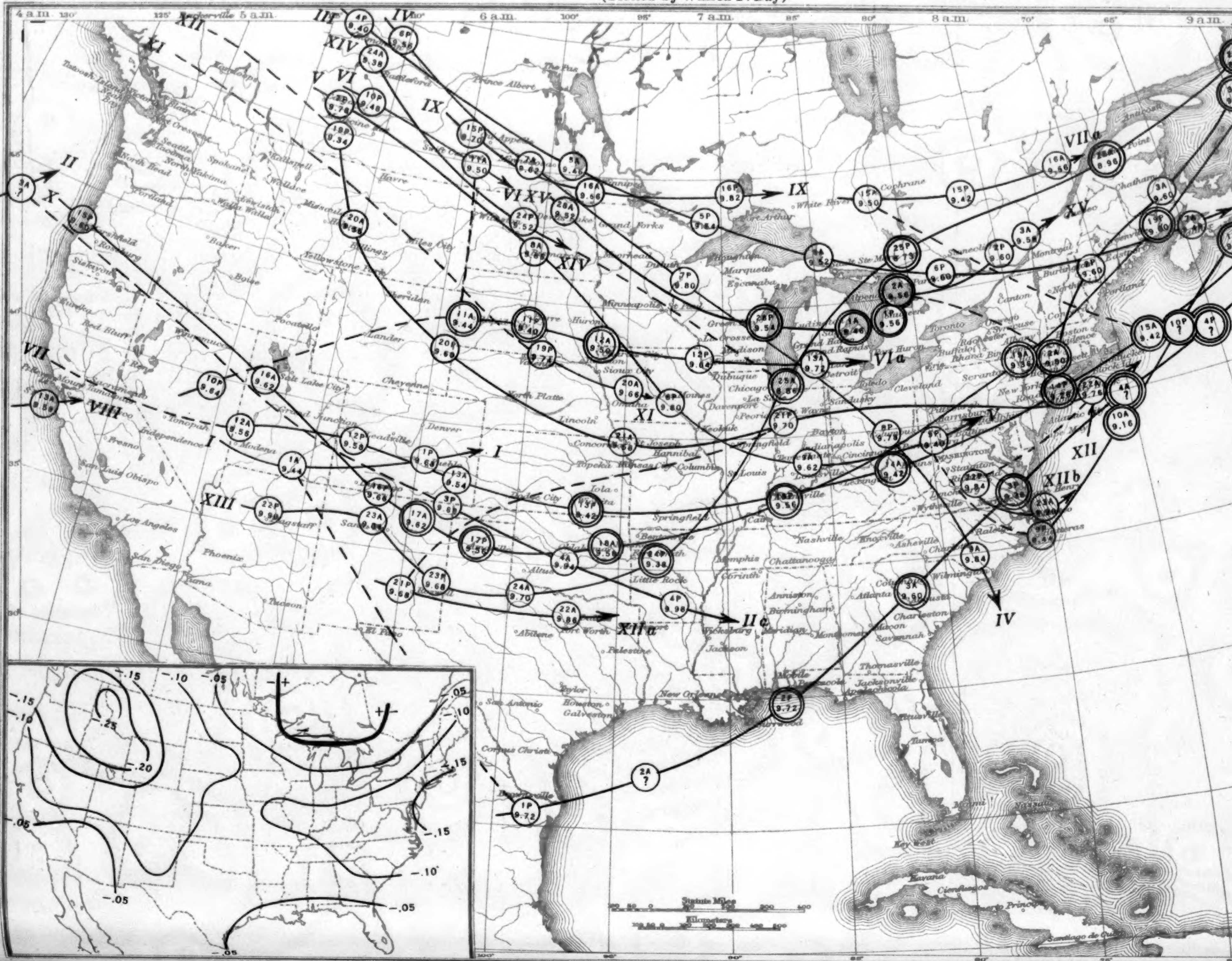


Chart III. Departure (°F.) of the Mean Temperature from the Normal, February, 1926

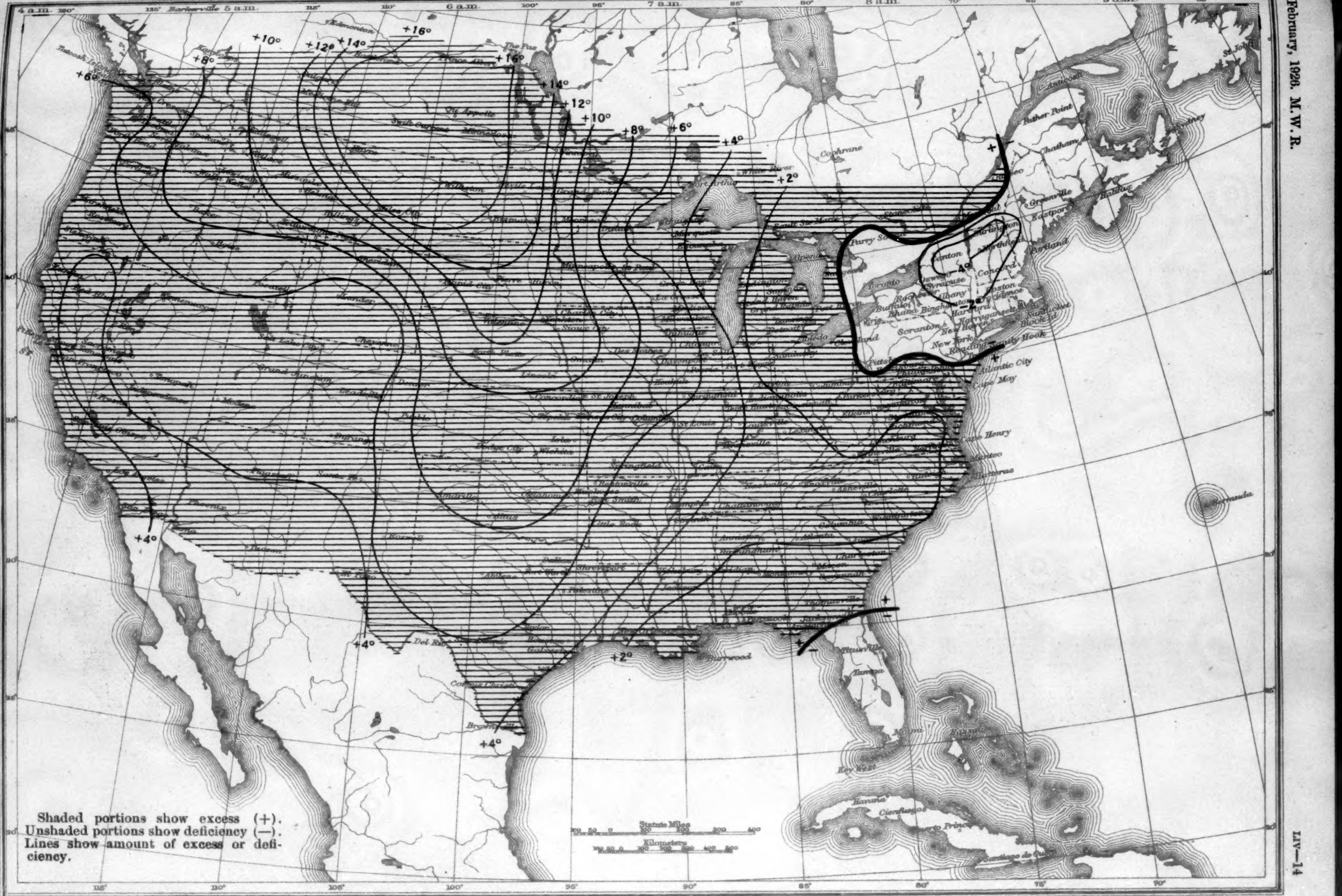
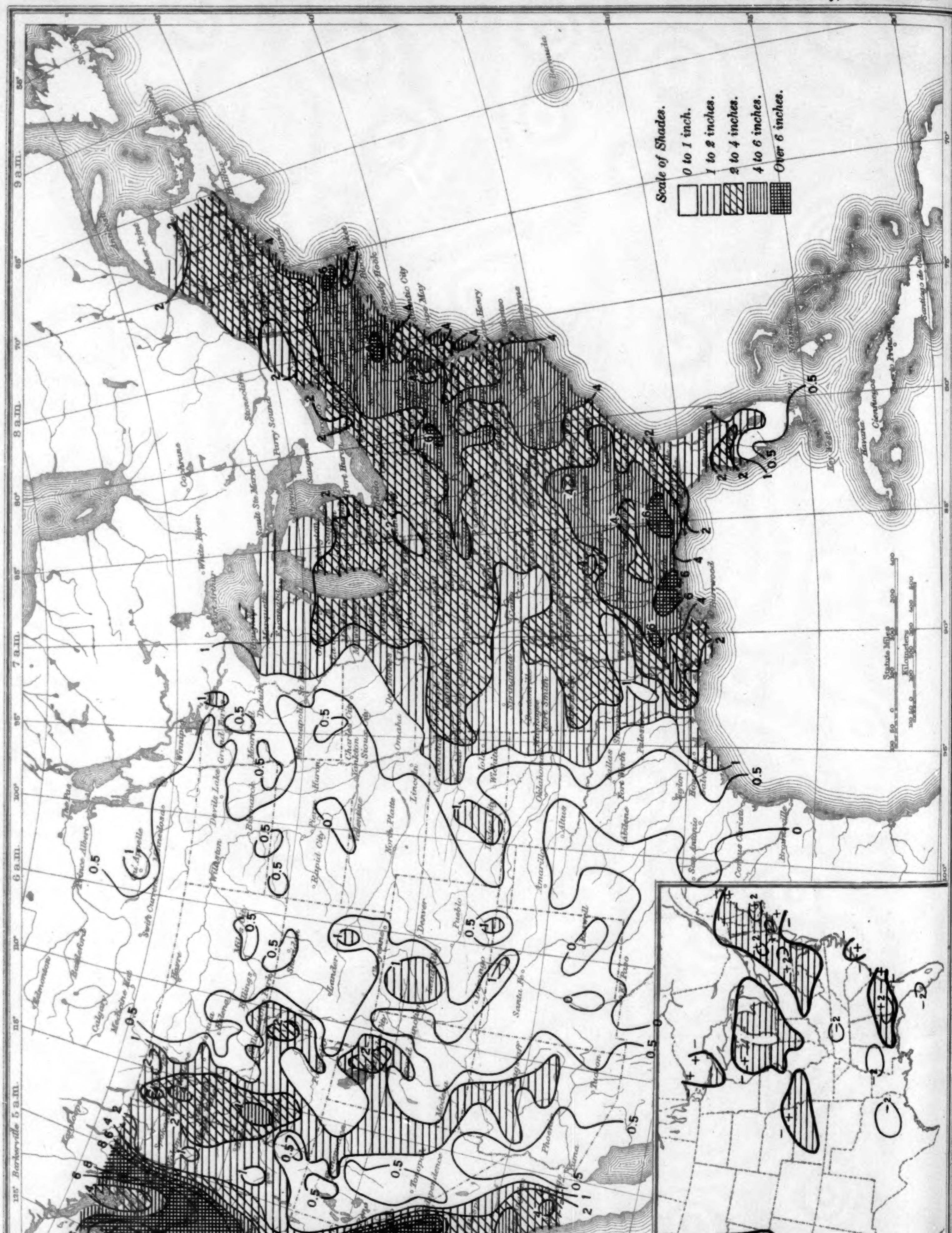


Chart IV. Total Precipitation, Inches, February, 1926. (Inset) Departure of Precipitation from Normal



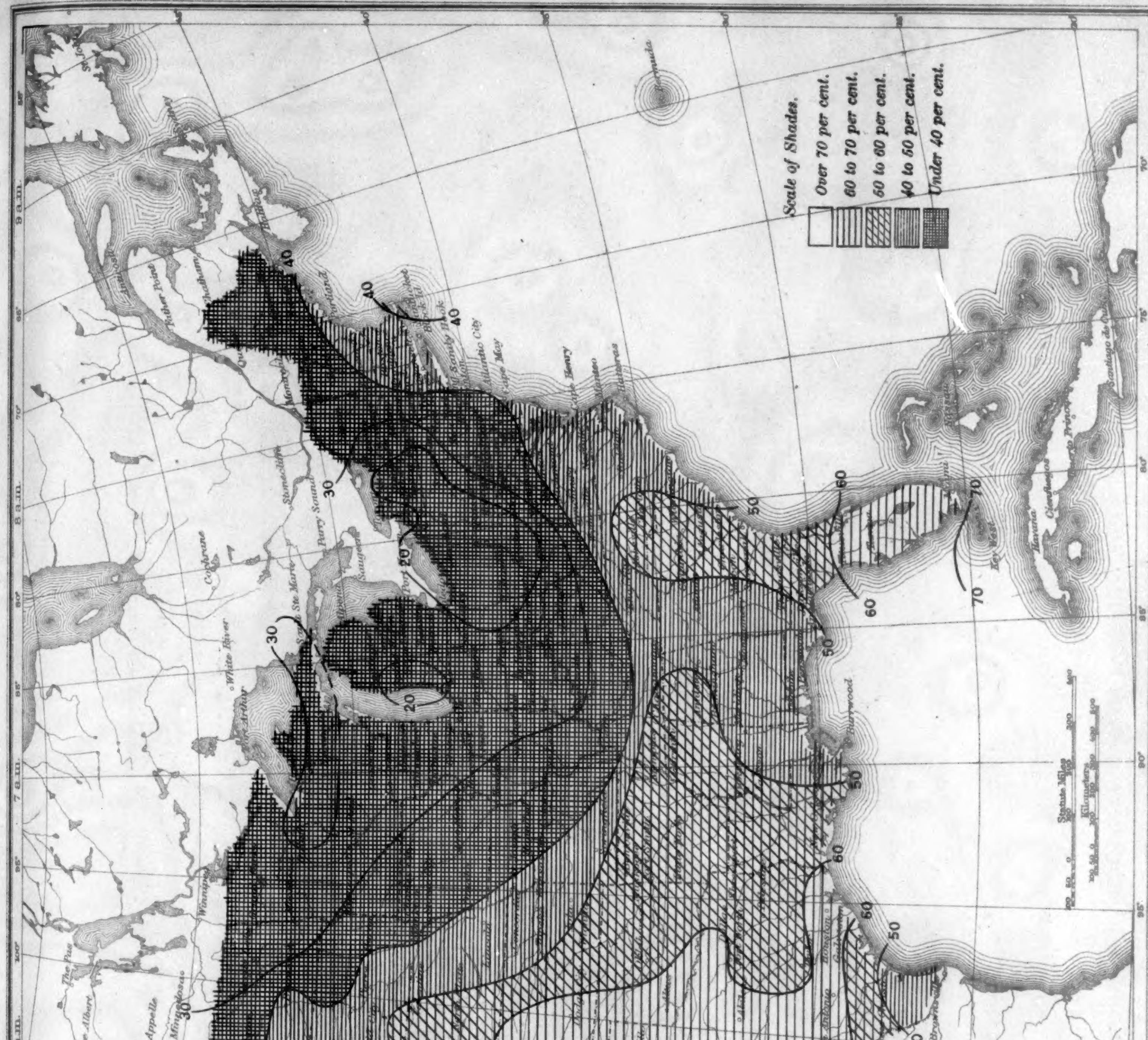
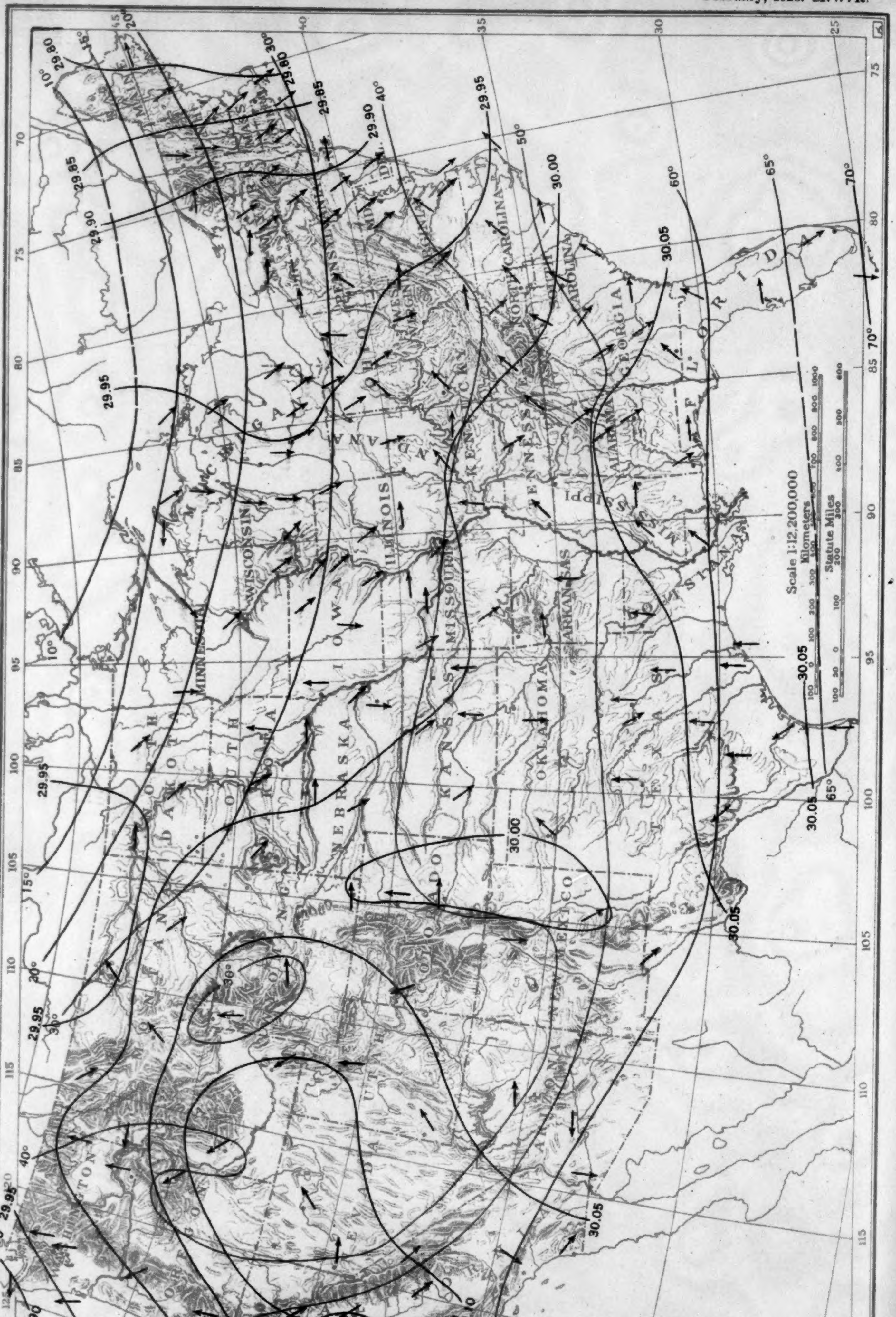
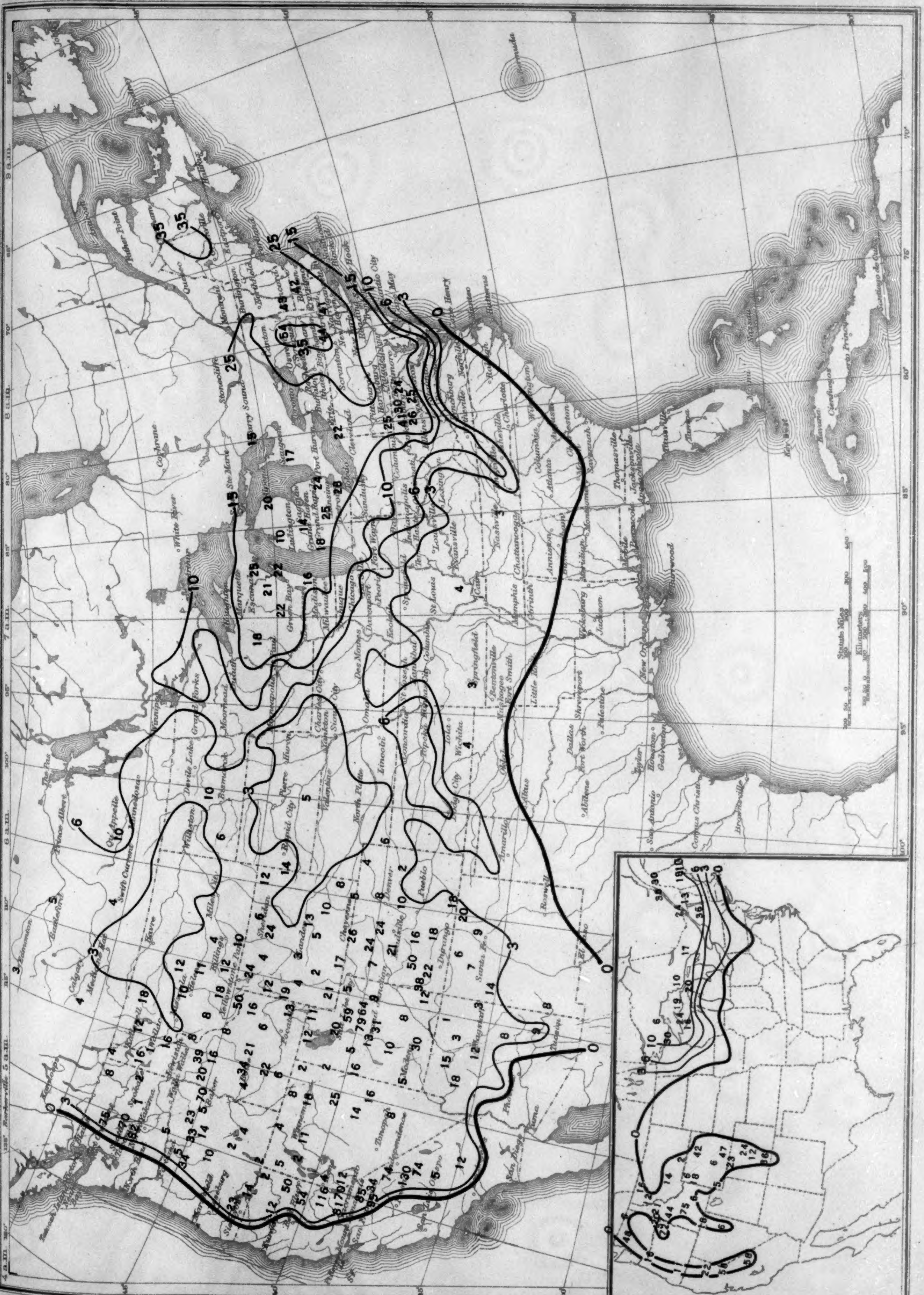


Chart V. Percentage of Clear Sky between Sunrise and Sunset, February, 1926.

Chart VI. Isobars at Sea-level and Isotherms at Surface; Prevailing Winds, February, 1926





(Plotted by F. A. Young)

(Plotted by F. A. Young)

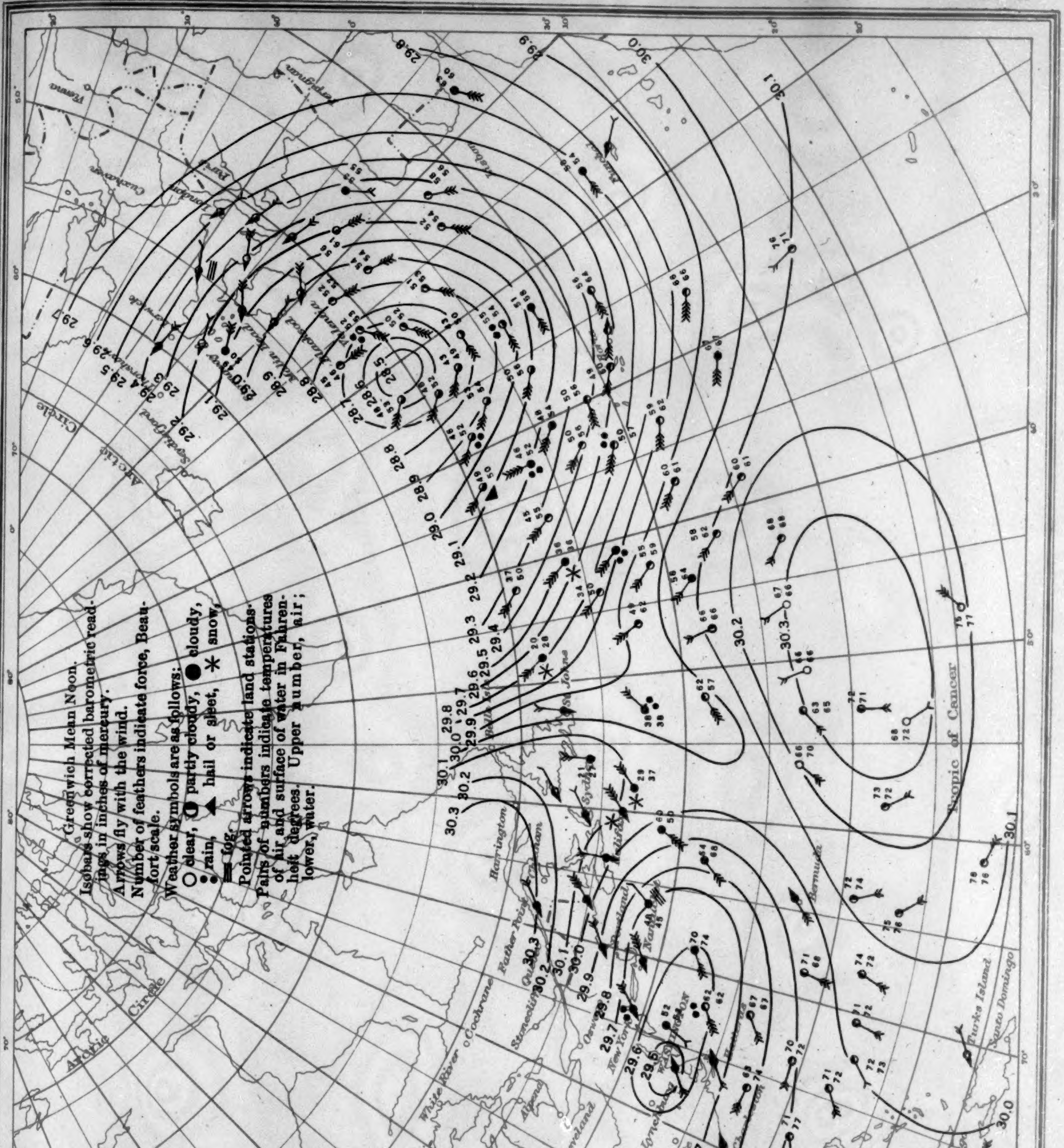


Chart IX. Weather Map of North Atlantic Ocean, February 2, 1926

(Plotted by F. A. Young)

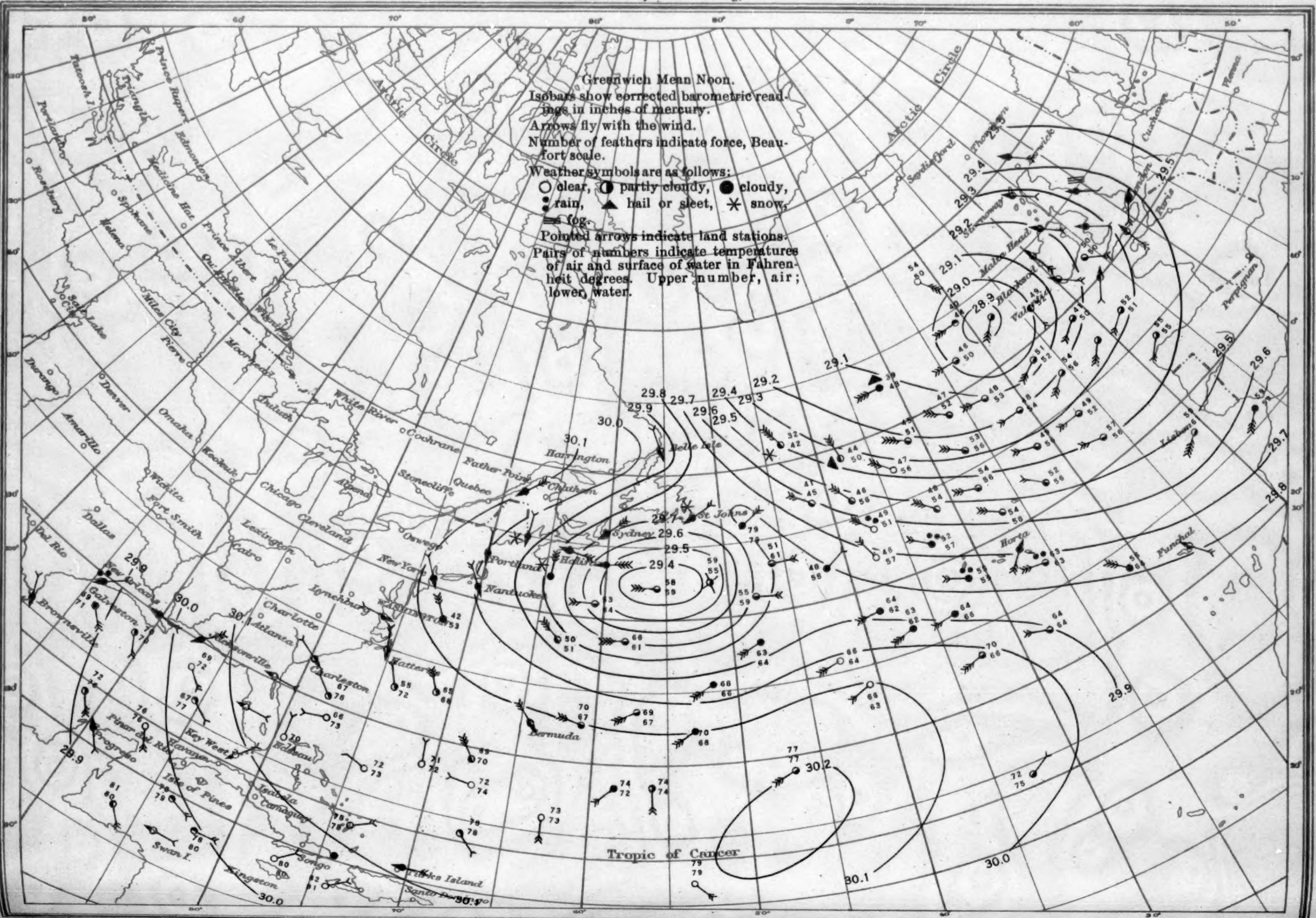


Chart X. Weather Map of North Atlantic Ocean, February 3, 1926
(Plotted by F. A. Young)

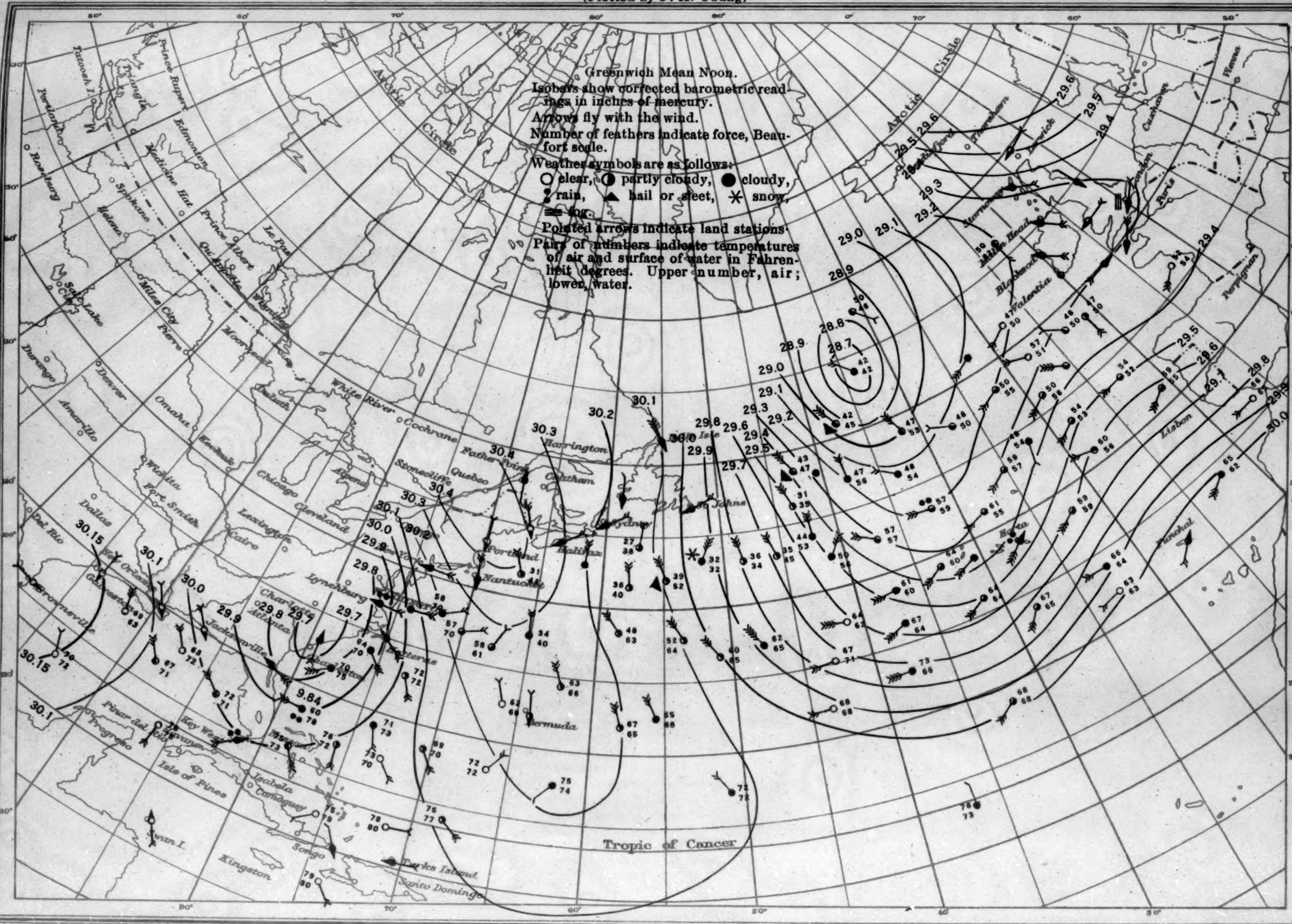
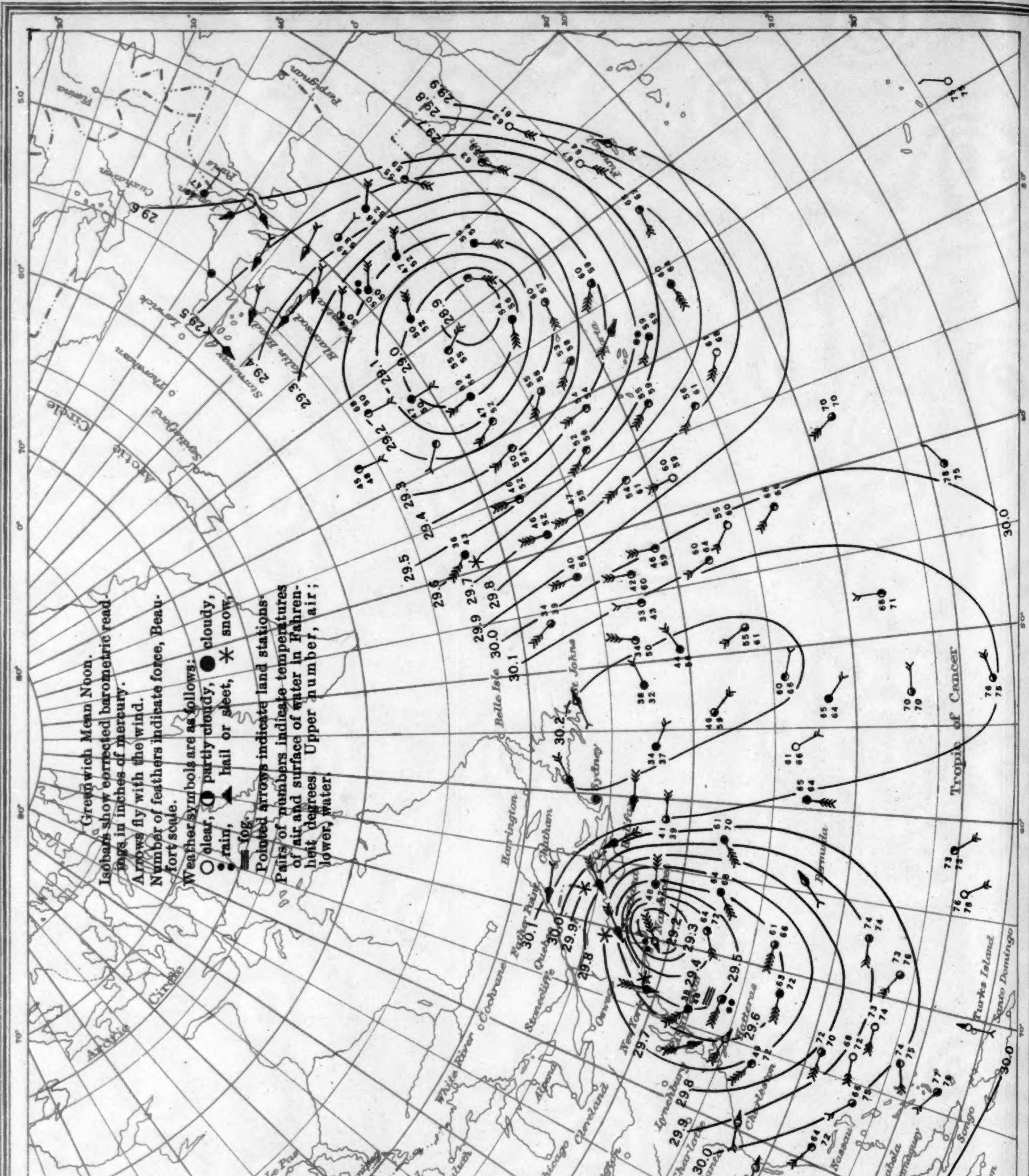


Chart XI. Weather Map of North Atlantic Ocean, February 4, 1926
(Plotted by F. A. Young)



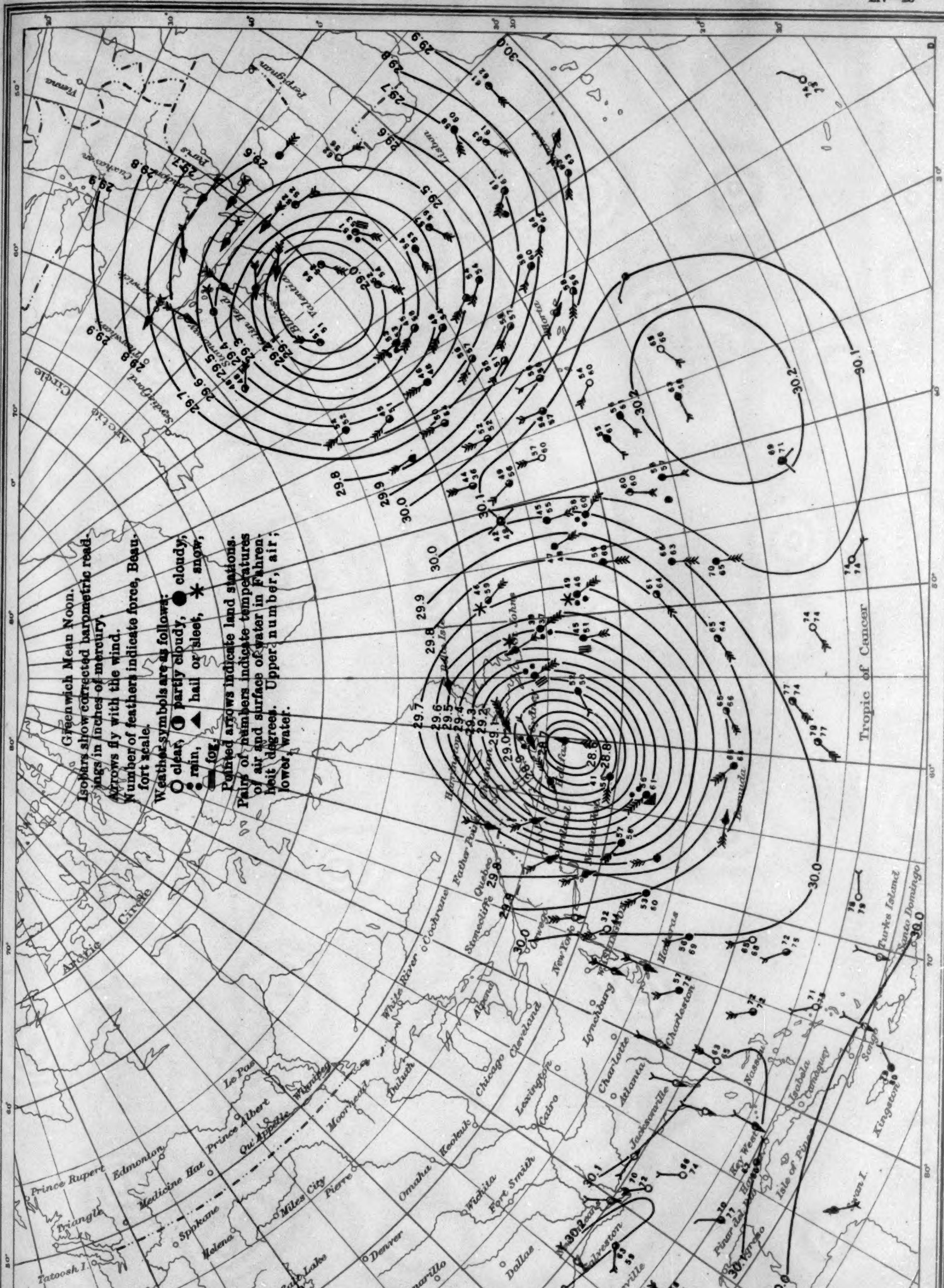

(Plotted by F. A. Young)
Greenwich Mean Noon.
Isobars show corrected barometric readings in inches of mercury.
Arrows fly with the wind.
Number of feathers indicate force, Beaufort scale.
Weather symbols are as follows:
clear, partly cloudy, cloudy, rain, hail or sleet, snow, fog.
Pointed arrows indicate land stations.
Pairs of numbers indicate temperatures of air and surface of water in Fahrenheit degrees. Upper number, air; lower, water.
Tropic of Cancer
Arctic Circle

Chart XIII. Weather Map of North Atlantic Ocean, February 6, 1926

(Plotted by F. A. Young)